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A department for the man who works at home with tools

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\$75 Prize Contest for Home Workers

Popular Science Monthly is offering each month a first prize of \$50 and a second prize of \$25 for the best articles describing things made at home. Every reader is eligible. See page 86 for the rules of the Contest.

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Secrets of Selling that Make These Men \$10,000 a Year Star Salesmen

Some Amazing Stories of Quick Success

IT is hard to believe that a man who has been working for years in a routine job at small pay could almost over-night step into the \$10,000 a year class. Yet that is just what many men have done and are doing today. That such big success could come so quickly and so easily seems almost incredible. If I should tell you that one man who had been a fireman on a railroad stepped from his old job to one that paid him \$10,000 a year, you would be inclined to doubt the truth of my statement.

But I can show you the man's own story. And that is only one instance. I can show you many more. And perhaps the most surprising part of it all is that these men were just average men. They came from all walks of life, from all fields of work. They had previously been clerks, bookkeepers, mechanics, farm hands! Some of them had never earned more than \$60 a month—some of them had drudged for years at dull, uninteresting work without prospects of anything better in life. And then, in one quick jump, they found themselves earning more money than they had ever thought possible. Suddenly all their dreams of success, position, and financial independence came true.

The Secret of Their Success

What was responsible for their remarkable rise to the ranks of the big money makers? What did they do to lift themselves out of the low pay rut and step to magnificent earnings?

The answer is very simple. These men decided to get into the great field of *Selling*—they learned about the wonderful opportunities in this fascinating profession—why salesmen are always in demand—why they receive so much more money than men in other fields of work. And they became Star Salesmen!

Probably if you had told any one of these men that it was possible for him to become a Star Salesman he would have laughed at the idea. If you had told him that it was not only possible, but that it could be done in his spare moments at home, without interfering with his work, he would have dismissed your statement as being too absurd to be even considered. For you must remember that most of those men had never had a day's experience in *Selling*—they had no special qualifications for Salesmanship—no thought of ever becoming Salesmen.

What Makes a \$10,000 a Year Star Salesman?

As a matter of fact, these men who are today reaping such handsome rewards as Star Salesmen would probably be working still as clerks, bookkeepers, mechanics, etc., if they had not learned about the National Salesmen's Training Association's system of Salesmanship Training and Free Employment Service. This is an organization of top-notch Salesmen and Sales Managers formed just for the purpose of showing men how to be-



Send Me Your Name

I have shown hundreds of men how to step from small-pay jobs into the big money class in one quick jump. \$10,000 a year—yes, and more—has come to men as a result of writing to me. Just let me send you the whole amazing proof—entirely free of cost or obligation—J. E. Greenslade, President, N. S. T. A.

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come Star Salesmen and fitting them into positions as City and Traveling Salesmen.

Through its help hundreds of men have been able to realize their dreams of big opportunity, success, wealth and independence. Men without previous experience or special qualifications have learned the secrets of selling that make Star Salesmen—for Salesmen are not "born" but made, and any man can easily master the principles of Salesmanship through the wonderful system of the National Salesmen's Training Association. Any one who is inclined to doubt that this is so has only to read the stories of men who tell in their own words what the Association has done for them. Here are just a few examples:

J. P. Overstreet of Dallas, Texas, who was formerly on the Capitol Police Force of Washington, D. C., states: "My earnings for March were over \$1,000 and over \$1,800 for the last six weeks, while last week my earnings were \$356. The N. S. T. A. dug me out of the rut where I was earning less than \$1,000 a year and showed me how to make a success."

C. W. Campbell, of Greensburg, Pa., writes: "My earnings for the past thirty days are \$1,562 and I won Second Prize in March, although I only worked two weeks during that month."

What These Men Have Done You Can Do

It will not cost you a penny to learn how you, too, can become a Star Salesman and take your place among the big money makers of business. Whatever your ambition may be—\$5,000, \$10,000 or more a year—find out about your great opportunity in the wonderful profession of Salesmanship. See how the N. S. T. A. can open to you the way to a big selling job, to prosperity and a life of fascinating work, travel, contact with influential men. Just mail the coupon or write, and you will receive, without cost or obligation, proof of what the remarkable system of the National Salesmen's Training Association and its FREE EMPLOYMENT SERVICE can do for you. In addition a great book on Salesmanship will be mailed to you without charge. You owe it to yourself to read of the quick and brilliant success that others have achieved and of the opportunities that await you in the field of Selling. Mail the coupon or write today.

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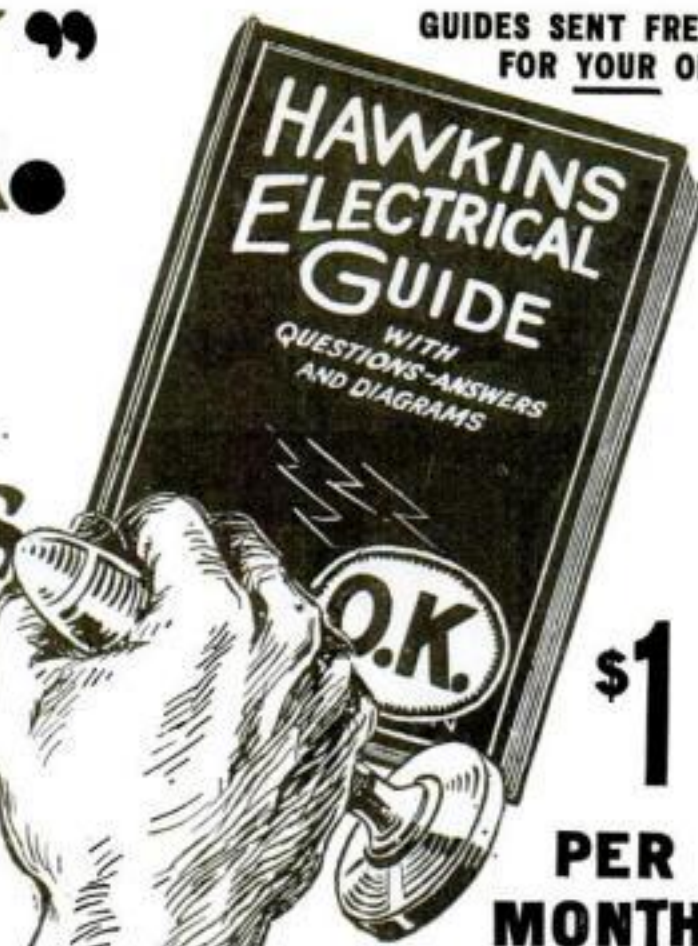
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nating current systems—switching devices—circuit breakers—relays—lightning protector apparatus—regulating devices—synchronous condensers—indicating devices—meters—power factor indicators—wave form measurement—switch boards. Alternating current, wiring power stations—turbines; management, selection, location, erection, testing, running, care and repair—telephones. Telegraph—simultaneous telegraphy and telephony—wireless—electric bells—electric lighting photometry. Electric railways—electric locomotives—car lighting—trolley car operation—miscellaneous applications—motion pictures—gas engine ignition—automobile self-starters and lighting systems, electric vehicles. Elevators—cranes—pumps—air compressors—electric heating—electric welding—soldering and brazing—industrial electrolysis—electroplating—electrotherapeutics—X-rays

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See the New Ideas for Men Who Work at Home with Tools, Classified in the Home Workshop Index on Page 2

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225 West Thirty-ninth St. New York City

\$240 in Prizes Offered in This Issue—See pages 74, 82, 86, and 104

QUICK-ACTION ADVERTISING

HERE READERS AND ADVERTISERS MEET TO TRANSACT BUSINESS

Rate 25 Cents a Word. Advertisements intended for the December issue should be received by October 1st

AUTOMOBILES AND ACCESSORIES

AUTO motors supplies: Buick—Michigan—Stoddard-Dayton—E. M. F. Cadillac—Overland—Continental and Buda Motors. All types, \$50.00 each and up. New Dixie Magneto \$20.00. Splitdorf High Tension Magneto \$10.00. Kellogg Pumps \$3.50. Auto-Lite generators, new \$10.00. Air Gauges \$6.50. Remy Ignition Coils, new \$3.00. Electric and gas headlamps, coils, distributor heads, air compressors, etc. Write for catalog. Motor Sales Dept. 14, West End, Pittsburgh, Pennsylvania.

WHAT do you need? We have it. Gray's Auto Parts Co., 3212 Brighton Road, Pittsburgh, Pennsylvania.

AUTOMOBILE Parts for all cars—50% off manufacturers' list price. Pistons, connecting rods, cam shafts, crank shafts, cylinders, axles and gears. Our new catalogue and Used Parts Bulletin now ready. Write for it to-day. Service and satisfaction guaranteed. Auto Parts Company, 4108 Olive Street, St. Louis, Missouri.

TOWLINES Sixteen feet long with hooks. Small enough for tool box. Replaced if broken within year. \$2.50 delivered. Agents price \$15.00 dozen. Sample \$1.50. Order sample today. Will buy back any you don't sell. The Superior Manufacturing Co., Penn Bldg., Cleveland, Ohio.

PATENTS—Write for Free Illustrated Guide Book and Evidence of Conception Blank. Send model or sketch and description of invention for our opinion of its patentable nature. Highest reference. Reasonable terms. Victor J. Evans & Company, 189 Ninth, Washington, D. C.

AUTOMOBILE Owners, Garagemen, Mechanics, Repairmen, send for free copy of our current issue. It contains helpful, instructive information on overhauling, ignition troubles, wiring, carburetors, storage batteries, etc. Over 120 pages, illustrated. Send for free copy to-day. Automobile Digest, 523 Butler Bldg., Cincinnati.

HOW to make automobile storage battery plates, \$1.00 postpaid. H. Deckelman, 7118 Nashville Avenue, St. Louis, Missouri.

MONEY Making Battery Charging Outfits. Air Compressors automatic. Easy monthly payments. Write us. Hobrosco, Troy, Ohio.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

FORD ACCESSORIES

WIZARD battery charger for Ford cars, charges 6-volt battery from Ford magneto. Attached to Ford in few minutes. Guaranteed to work perfectly. Hundreds in use. No more oil lamps, electrify your Ford. Price \$6.95, postage prepaid. Send money order. Agents wanted. Write for circular. Wizard Mfg. Company, 206 Jefferson Street, Portland, Oregon.

STARTER for Ford, \$20. Guaranteed. American-Simplex Company, Anderson, Indiana.

WELDING AND SOLDERING

WELDING Plants for all purposes. Small payment, balance six to ten months. Apparatus guaranteed for one year. Bertschy Engineering Company, Dept. 2, Cedar Rapids, Iowa, U. S. A.

ELECTRICAL

FREE catalogue of electrical goods at bargain prices. Write now. Holmes Electric Company, Area, Illinois.

CONNECT or disconnect your storage battery in one second. F. & M. non-corroding self-locking terminals. \$2 set. Marsh, Naugatuck Avenue, Devon, Connecticut.

WANTED

WANTED—Representatives in every Factory in the United States. Popular Science Monthly, 225 West 39th Street, New York.

DUPLICATING DEVICES

"MODERN" Duplicators. Business Getters. \$2.25 up. 50 copies from pen, pencil, typewriter. No glue or gelatine. 40,000 in use. Free trial. Need one? Booklet free. J. V. Durkin-Reeves Co., Pittsburgh, Pennsylvania.

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MOTORCYCLES, BICYCLES, SUPPLIES

USED motorcycle parts half price. Schuck Cycle Company, 1922 Westlake, Seattle, Washington.

LARGEST stock of new and used motorcycle parts and accessories in the world at your disposal via Uncle Sam's mail. Write for quotations. Motorcycle Parts Mfg. Co., 2030-36 Wabash Avenue, Chicago, Illinois.

HAVE you a hobby? Why not make models? The book Model Making will tell you how to make steam engines, gas engines, boats, locomotives, guns, etc. It also describes the various mechanical processes connected with model making such as soft and hard soldering, lathe work, pattern making and woodwork. Price \$3.00 postpaid. Popular Science Monthly, 225 West 39th Street, New York.

FORMULAS

FREE—Formula Catalog. Laboratories, Boylston Building, Chicago.

FORMULAS—All Kinds. Catalogue free. Bestovall Laboratories, 4047 N. Whipple, Chicago.

FORMULA for positive fire extinguisher \$1.00. Sheldon Krieger, Metamora, Michigan.

PRECIOUS Gems Formulas. Complete set for 50 cents. Klugh Bros., Ridgway, Pennsylvania.

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A 20% Discount For Six Insertions

Ever since Popular Science Monthly assumed its present popular style, in October, 1915, it has stood second in the volume of Classified advertising carried in the national magazines. During that time about 80% of its advertisers have used space consistently—month after month, year after year—without omission. The other 20% have used space spasmodically and their results have undoubtedly been in proportion. In appreciation of those advertisers who find it profitable to be represented in every issue, we are offering a special discount of 20% for six consecutive insertions. YOU can start your advertisement in the next issue and, by running it six months, earn a 20% reduction from the flat rate of 25 Cents a Word. On six insertions of a 30 word advertisement this means a saving of \$9.00—deductable from the sixth insertion. Not a bad offer, is it? If you want to reach 250,000 BUYERS every month at this unusually low rate, send your order NOW to

Classified Advertising Manager,

POPULAR SCIENCE MONTHLY,
225 West 39th Street,
New York City.

MANUFACTURING

WE do Metal Stamping, Gold, Silver, Nickel, Brass and Copper finishing. We will manufacture your article either on time or contract basis. If interested in large production write us. When on your die work you are always welcome at our die-maker's bench. Denning Mfg. Company, 1775-1777 East 87th Street, Cleveland, Ohio.

LET us be your factory! Write to-day. Logan Machine Company, 222 South Clinton Street, Chicago, Illinois.

WE manufacture anything, develop and build special machinery. Get our booklet it's valuable to you. R. G. Clyne Engineering Co., St. Louis, Missouri.

COMPLETELY equipped Machine Shop and Wood Working Plant wants to manufacture Devices. Easy to market. Royalty basis. Post Office Box 285, Pittsburgh, Pennsylvania.

AVIATION

PROPELLERS for air propulsion. 5 ft. diameter \$12. Other sizes in proportion. Hub mountings, bearings, sprockets and countershafts complete. Full scale blue prints for motorcycle-driven snow and ice sleds, 75c. Ford type, \$1. Crawford Motor and Aeroplane Mfr., 142 South Rampart Street, New Orleans, Louisiana.

OUR New 1921 Large Aeronautical Supply Catalog now off the press. Late ideas and low prices. Send 15c. Our Ford and Motorcycle Airplane pamphlets describe the most complete little machines on the market. Propeller Catalog also. 4c each. Heath Airplane Company, Chicago.

INVENTORS desiring information write for our Free Illustrated Guide Book and Evidence of Conception Blank. Send model or sketch of invention for our opinion of its patentable nature. Highest references. Prompt service. Reasonable terms. Victor J. Evans & Company, 151 Ninth, Washington, D. C.

LEARN to fly with America's oldest aircraft company. 6 hours flying worked in with 3 months shop training at \$190, makes our course the most complete ever offered, and an opportunity long waited for. Enroll at once. Heath Airplane Company, Chicago.

FIREARMS

BARGAIN—Remington high power, bolt action rifle factory, new condition, \$9.75. Ben Sloan, 247 West 42d Street, New York.

ADDING MACHINES

THE "Lightning Calculator" Adds, Subtracts, and Multiplies. The action is simple, rapid, exact and guaranteed for 5 years. Price \$15.00. L. Lemon, 16 N. Hoyne Avenue, Chicago.

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MODEL AND MODEL SUPPLIES

MODEL makers: Do you use engines, boilers, pumps, fittings, rods, tubings, etc? We are America's leading manufacturers. Complete catalog, 10c. Model Supply, 505B Fifth Avenue, New York.

MODEL aeroplanes that fly. Buy your complete outfit, scale drawings, fittings, compressed air motors and all best model aeroplane supplies from the Wading River Manufacturing Company. Established 1909. Our new fifty-two page catalog illustrates twenty-four latest models and designs. Send 10c for your copy. Wading River Manufacturing Company, 672B Broadway, Brooklyn, New York.

WE make working models for inventors and do experimental work, and carry a complete stock of brass gears and model supplies. Send for catalogue. The Pierce Model Works, Tinley Park, Illinois.

MODELS and Experimental Work of every description. Lamson Model and Experimental Works, 625 West Jackson Boulevard, Chicago.

MODEL Steam Engines, Boilers, Electric and Steam Boats, Yachts, Model Ship's Fittings and Model Makers' supplies. Send 20c for new large illustrated catalogue. Bathe Mfg. Co., Dept. C, 5214 Woodland Ave., Philadelphia, Pennsylvania.

WORKING drawings and models made from your sketches and ideas. We back our guarantee with 30 years experience. D. J. Beeton & Co., Roanoke, Virginia.

GET our booklet before placing order for models or anything you need. Our work the best, our prices right, our dealings square. R. G. Clyne Engineering Co., St. Louis, Missouri.

MOTORS, ENGINES, MACHINERY

ELECTRIC Motors, 50 heavy duty 1/4 H. P. motors. General Electric and other standard makes. 110 volt, 60 cycle, single phase. Brand new, never unpacked. Guaranteed perfect. \$20.00 and \$25.00. Pennsylvania Motor Exchange, Lancaster, Pennsylvania.

SPECIAL garage motors: Manufactured by the General Electric Co. 1 H.P. \$78.50—2 H.P. \$110.00—3 H.P. \$128.50—5 H.P. \$165.50. All sizes both single and Polyphase Motors for immediate delivery. Special charging generators all voltage. Write for catalog. Motor Sales Dept. 14, West End, Pittsburgh, Pennsylvania.

ELECTRIC Motors, Lighting Generators, Battery Chargers. Easy monthly payments. Write us. Hobartco, Troy, Ohio.

1/4 to 1/50 H. P. Motors \$6.00 to \$20.00. State your needs. Motormart, 1017 Asquith, Baltimore, Maryland.

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MISCELLANEOUS

MAKE Your Rope and Fishing Line at Home. Illustrated, thorough. 30c postpaid. Dale VanHorn, Lincoln, Nebraska.

HOW to build beautiful Homes at small cost. For full information send for my free circulars. Peter de Linde, Zion, Illinois.

How Would You Like to Earn \$83 a Day?

The true story of J. F. James, the shipping clerk who became president of a great manufacturing company. What was the secret of his success?

By Richard W. Samson

THE other day I spent a few precious hours with Mr. J. F. James, President of the Mascot Stove Manufacturing Company, of Chattanooga, Tennessee.

Fifteen years ago he was working as a shipping clerk in a stove foundry for \$9 a week. Today he is making \$25,000 a year, or \$83 a day. As Mike Murphy, the famous college trainer, used to say—"You just can't beat a man who refuses to be beaten."

Somehow, whenever I meet a man like this, and learn the story of his life, I am doubly glad that I am an American.

For this is truly The Golden Land of Opportunity. "The barriers are not yet erected which shall say to aspiring talent—"Thus far and no farther."

Few men have started life with as barren prospects as J. F. James. Born in the mountains of East Tennessee, forced to go to work before he had completed his education, he might easily have fallen into the rut of mediocrity and stayed there.

But one day, glancing through a magazine, he came across an advertisement which appealed to him so strongly that he read it twice and then tore it out of the magazine to read again.

It told how thousands of other men had won promotion through spare time study. How they had trained themselves to do bigger things! How they were ready and waiting when Opportunity came!

THAT day J. F. James made a resolution. He said that what others were doing, he could do! So he tore out that familiar coupon, marked it, signed it, and mailed it to Scranton. Though he did not fully realize it at the time, he had taken the first step along the Up-road to Success.

So it came about that J. F. James studied while other men wasted their time shooting pool or playing pinochle or watching the clock. They are still doing it today—worn, discouraged men who cry out that Fate is against them and that "they never had a chance."

Doomed forever to small wages, fighting a losing fight against poverty, missing the really good things of life, they cannot understand how "Jimmy" James got ahead.



J. F. JAMES

Just 40 years old and earning \$25,000 a year. To young men he says:—"Stop killing time. Study the theory of your work. Then you're bound to succeed."

"I didn't make a drudge of myself," said Mr. James the other day. "I had time for baseball and everything that seemed worth while. I had just as much fun as the other fellows, but instead of wasting time, I turned it into gold through my I. C. S. course."

"Every hour I invested in study has paid me better than any other investment I ever made."

"It has brought me a large income—the satisfaction that goes with success—the money to buy anything I want—a good home and an automobile for my wife and children—the esteem of all my friends. I feel that I owe the I. C. S. a debt that I can never repay. They made my success possible."

WHAT about you? Are you satisfied to stand just where you are? Or do you really want to be somebody? It all depends on what you do in your spare time.

"There is not a man in power at the Bethlehem Steel Works today," says Charles M. Schwab, "who did not begin at the bottom and work his way up. They won by using their normal brains to think beyond their manifest daily duty."

And one of these executives earns a million dollars a year!

The difference between a successful man and a failure is almost always a matter of training.

As Andrew Carnegie said:—"Although my whole works were to be burned down, it wouldn't be a fatal blow—if I still had my organization, my trained men."

You can be one of these trained men. You can get the training you need right at home in spare time.

For thirty years, the International Correspondence Schools have been helping men out of routine drudgery into work they like—helping them to win advancement, to have happy, prosperous homes, to know the joy of getting ahead in business and in life.

In offices, mills, shops, stores, factories—in every line of endeavor—I. C. S. men are "the first to be hired and the last to be fired."

How much longer are you going to wait before taking the step that is bound to bring you more money? Isn't it better to start now than to wait five years and then realize what the delay has cost you?

One hour after supper each night spent with the I. C. S. in the quiet of your own home will prepare you for the position you want.

Here is all we ask: Without cost, without obligating yourself in any way, mark and mail the coupon. It takes but a moment of your time, but it is the most important single thing you can do today! *Do it right now!*

TEAR OUT HERE
INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 7436-B SCRANTON, PA.

Without cost or obligation, please explain how I can qualify for the position, or in the subject before which I have marked an X in the list below:—

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| <input type="checkbox"/> ELEC. ENGINEER | <input type="checkbox"/> BUSINESS MANAG'MT |
| <input type="checkbox"/> Electric Lighting & Bys. | <input type="checkbox"/> SALESMANSHIP |
| <input type="checkbox"/> Electric Wiring | <input type="checkbox"/> ADVERTISING |
| <input type="checkbox"/> Telegraph Engineer | <input type="checkbox"/> Railroad Positions |
| <input type="checkbox"/> Telephone Work | <input type="checkbox"/> ILLUSTRATING |
| <input type="checkbox"/> MECHANICAL ENGR. | <input type="checkbox"/> Show Card & Sign Ptg. |
| <input type="checkbox"/> Mechanical Draftsman | <input type="checkbox"/> Cartooning |
| <input type="checkbox"/> Machine Shop Practice | <input type="checkbox"/> Private Secretary |
| <input type="checkbox"/> Toolmaker | <input type="checkbox"/> Business Correspondent |
| <input type="checkbox"/> Gas Engine Operating | <input type="checkbox"/> BOOKKEEPER |
| <input type="checkbox"/> CIVIL ENGINEER | <input type="checkbox"/> Stenographer & Typist |
| <input type="checkbox"/> Surveying and Mapping | <input type="checkbox"/> Cert. Pub. Accountant |
| <input type="checkbox"/> MINE FOR'N or ENGL. | <input type="checkbox"/> TRAFFIC MANAGER |
| <input type="checkbox"/> STATIONARY ENGR. | <input type="checkbox"/> Railway Accountant |
| <input type="checkbox"/> Marine Engineer | <input type="checkbox"/> Commercial Law |
| <input type="checkbox"/> ARCHITECT | <input type="checkbox"/> GOOD ENGLISH |
| <input type="checkbox"/> Contractor and Builder | <input type="checkbox"/> Com. School Subjects |
| <input type="checkbox"/> Architectural Draftsman | <input type="checkbox"/> CIVIL SERVICE |
| <input type="checkbox"/> Concrete Builder | <input type="checkbox"/> AUTOMOBILES |
| <input type="checkbox"/> Structural Engineer | <input type="checkbox"/> Railway Mail Clerk |
| <input type="checkbox"/> PLUMBING & HEAT'G | <input type="checkbox"/> Mathematics |
| <input type="checkbox"/> Sheet Metal Worker | <input type="checkbox"/> Navigation |
| <input type="checkbox"/> Text. Overseer or Supt. | <input type="checkbox"/> Agriculture |
| <input type="checkbox"/> CHEMIST | <input type="checkbox"/> Poultry |
| <input type="checkbox"/> Pharmacy | <input type="checkbox"/> Banking |
| | <input type="checkbox"/> Spanish Teacher |

Name _____

Street and No. _____

City _____ State _____

Occupation _____



New Easy Way To Learn Drawing

How you can earn big money in Commercial Art, Illustrating, Designing, or Cartooning, without being a "genius," and regardless of your present ability.

Never was there such a need for artists as today! Business, revitalized, needs thousands. Illustrated catalogs, advertisements, posters, circulars, trade-mark designs—countless pieces of art work are needed by the busy business world. 48,868 periodicals are published in America—every one of them needs the services of **at least two artists for each issue.** You can't begin to realize the gigantic amount of art work that must be done—and the demand is increasing daily. Big money is gladly paid—and big money is waiting for anyone with foresight enough to prepare for this pleasant profession. Thru our new easy method of teaching, **YOU** can earn \$40 to \$100 a week as an artist, regardless of your present ability.

Learn in Spare Time

This new method is like a fascinating game. No matter how little you may know about drawing, no matter whether people tell you "you have no talent," no matter what your present ability may be—if you can write we can teach you to draw. The new method simplifies everything—all the red-tape, "art for art's sake" teaching and superfluous theory is taken out and in its place is put definite, practical instruction so that you will **make money in the art game.** The course is the work of an expert—Will H. Chandler, an artist of over 35 years' practical experience. And all your instruction is under the personal supervision of Mr. Chandler.

Write for Interesting Free Book

An interesting and handsomely illustrated booklet, "How to Become an Artist," has been prepared and will be sent to you without cost if you mail the coupon below. Mail coupon NOW for this attractive free book and full details about our Special Offer of a **FREE ARTIST'S OUTFIT** to every new student. No obligation whatever. Address

Washington School of Art, Inc.
Room 1683 Marden Bldg., Washington, D. C.

WASHINGTON SCHOOL OF ART, Inc.

Room 1683, Marden Bldg., Washington, D. C.

Please send me, without obligation, free book "How to Become an Artist" together with full particulars of Free Artist's Outfit to every new student.

NAME.....
(State whether Mr., Mrs., or Miss)

ADDRESS.....

TOOLS AND SUPPLIES

HAND Saws Sharpened. Arthur Lettau, Spotswood, New Jersey.

DRAFTING

DRAFTING—We design, perfect, manufacture or market anything mechanical. Keystone Engineering Company, 236 West 55th Street, New York City.

CHEMICALS

CHEMICALS, glassware—complete supplies for the chemical laboratory. Catalogue 5 cents. National Scientific Supply Co., 241 Pennsylvania Avenue, Washington, D. C.

FOR THE HOME

GRANDFATHER clock works, \$5.00. Build your own case, instructions free; make good profits selling your friends. Clock works with chimes for old or new cases. Write for full particulars. Clock Co., Nicetown, Pennsylvania.

MAKE an Electric Fountain and save over half. Beautiful and useful decoration for homes and public places. Big profits. We furnish parts. Directions—25c. Motormart, 1017 Asquith—Baltimore, Md.

AMERICAN MADE TOYS

MANUFACTURERS wanted for large production and homeworkers on smaller scale for Metal Toys and Novelties. Toy Soldiers, Cannons, Cowboys, Indians, Buffalo Bills, Wild Animals, Whistles, Bird-Whistles, Race Horses, Prize-Fighters, Wagtail Pups, Put and Take Tops and hundreds of other articles. Hundreds and thousands made complete per hour. No experience or other tools needed. Bronze casting forms, complete outfit from \$5.00 up. We buy these goods all year, paying fixed prices. Contract orders placed with manufacturers. Exceptional high prices paid for painted goods. An enormous business for this year offers industrious men an excellent opportunity to enter this field. Write us only if you mean real business. Catalog and information free. Metal Toy Manufacturing Co., 1696 Boston Road, New York.

FOR BOYS

PLAY Mouth-organ. Complete, easy instructor, 25c. Elsen, Publisher, Bowling Green, Ohio.

STAMPING NAMES

MAKE \$19.00 Hundred Stamping Names on Key checks. Send 25c for sample and instruction. PS Keytag Company, Cohoes, New York.

\$30 WEEK, spare time, stamping names on key-checks. Samples 25c. Particulars stamp. Jewell Keycheck Company, Dept. F, Shelby, Ohio.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

ROOTS—HERBS—PLANTS

GALLSTONES. I suffered agony—feel fine now—gallstones gone—no operation—particulars free. Mr. Due, Glen Ridge, New Jersey.

MEXICAN Wonder! Marvel of plant kingdom, grows in few minutes, postpaid 25c. Hygrade Sales Co., Box 576, Cleveland, Ohio.

HAWAIIAN—Silversword. Almost extinct. Specimen 25c. Whole plant \$100.00. "Silversword," Box 33, Paia, Maui, Hawaii.

MISCELLANEOUS

LUMINOUS paint. Bottle 20c. Laboratories J, Box 316, Portland, Oregon.

TATTOOING an interesting Art. Write for Supply catalog. Prof. J. Barber, 111 East Third, Cincinnati, Ohio.

X-RAY—Wonderful instrument producing optical illusions. See what is apparently bones in fingers, etc. Price \$1.00. Agents wanted. Frank Sears, 34 Globe Street, West Springfield, Massachusetts.

TELEGRAPHY

TELEGRAPHY (both Morse and Wireless) and Railway Accounting taught quickly. Big salaries. Great opportunities. Oldest and largest school; established 46 years. All expenses low—can earn large part. Catalog free. Dodge's Institute, K street, Valparaiso, Indiana.

LETTER SPECIALISTS

FRANCIS writes the Best Sales Letters in the World. Floyd DeLos Francis, Box 604, Atlantic City, New Jersey.

SALES letters that get the business. Correct methods and reasonable rates. Box 41, Berwick, Pennsylvania.

LETTERS applying for a position of any nature expertly written. \$1.00. Floyd V. Studer, Canadian, Texas.

STAMMERING

STAMMERERS—You can be permanently cured by my course of private individual lessons. Interesting booklet free. Samuel E. Robbins, 246 Huntington Avenue, Boston.

ST-TUT-T-T-TERING and Stammering cured at home. Instructive booklet free. Walter McDonnell, 59 Potomac Bank Building, Washington, D. C.

ADVERTISING

ONE Inch Advertisement in 100 country town newspapers, \$12.00. Ad-Guide free. Concordia Magazine, 2DW York, Pennsylvania.

IMITATION Money for advertising; samples; stage money 30c 100. Federal Book Co., 642 D Northeast, Washington, D. C.

TYPEWRITERS AND SUPPLIES

A.L.L. makes, \$15.00 up; fifteen days' free trial. Catalogue mailed on request. Henry Typewriter Company, 217 West 125th Street, New York City.

USED check writers, all makes, wholesale, retail. Dealers, corporation requiring one-fifty write me. Allen, Farnham Bldg., Omaha.

FOR SALE

U. S. and Foreign military medals, insignias and decorations of all kinds. Ben Sloan, 247 West 42nd Street, New York.

PATENTS FOR SALE

AN opportunity! Patent No 1366511 for sale outright or royalty. Timely, much needed invention of Recess Valve Tappet Adjusting Screw. No more valve sticking, wasted time or needless expense. Every car and truck owner will buy on sight. Overcomes warping of the valve stem. Eliminates friction and costly wear and tear due to overheating, expanding and bending under extreme compression. Insures perfect alignment of the valve stem at all times. 12,000,000 potential buyers. Should sell for \$1.00. Enormous profits. Investigate to-day! Lawrence L. Bedell, 45 Perry Avenue, Norwalk, Connecticut.

FOR Sale Double Speed Wrench. P. Firpo, 845 S. Monroe St., Stockton, California.

PATENT No. 1371195 pie cutter. New invention, inexpensive to manufacture, unlimited market, for sale outright or royalty. Walter Boyce, McGregor, Iowa.

WE have a few practical money making inventions for sale or trade. Adam Fisher Mfg. Co., 183B, St. Louis, Missouri.

TWO patents for sale on windows of sliding sash—kind can be cleaned from inside. Charles L. Johnson, 901 Lyndale Avenue, Trenton, New Jersey.

PRINTING, ENGRAVING, MULTIGRAPHING

5000 1x2 Labels \$2.50. Save 30%. Wolf Labels, Station E, Philadelphia.

250 BOND Letterheads and 250 Envelopes for \$2.75. Write for Pricelist and Samples. Balkow Printing Company, Meriden, Connecticut.

LETTERHEADS, Envelopes, 500 \$2.65. Samples Free. Quality Printery, Marietta, Ohio.

BETTER printing for less money! Send for our large package of samples of hundreds of items every user of printing is interested in. These samples worth dollars will be sent for 10 cents to pay postage. Ernest Fantus Company, 525 South Dearborn Street, Chicago.

PRINTING—The Better Kind. Gummed Labels, etc. May we quote you on your needs? Olde Tye Press, 328 Richards Avenue, S., Dover, New Jersey.

ENGRAVED stationery at 60% saving. Plates unnecessary. Cards, Letterheads, Announcements, etc. Samples sent. Alden Non-Plate Engraving Company, 15 Avon Street, Boston, Massachusetts.

125 Letterheads and 125 Envelopes, \$2.10 postpaid. Samples 5c. Wellman Printing, Huntington, West Virginia.

EMBOSSER Business, Personal Stationery. Samples, Stamp. Daniels P. Company, Pittston, Pennsylvania.

QUALITY PRINTING—1,000 Letterheads, Envelopes, Cards or Statements, \$3.00. Gum Labels 50c. per 1,000 up. Multigraph Letters, \$5.00 1,000. Samples free. Howlett's, Paris, Illinois.

PRINTING card or catalog. Our prices talk. Samples free. A. H. Kraus, 409 Chestnut Street, Milwaukee, Wisconsin.

SEND 2c for our Samples before ordering. "Mailorpress," 3125 Wentworth, Chicago.

INFORMATION

INFORMATION furnished. All subjects. Charge \$1.00 per subject. Money back guarantee. Answerall Information Bureau, 463 East 185th Street, New York.

AMATEURS, Experimenters, Inventors. Information furnished regarding technical and engineering problems, industrial technology, mathematics, chemistry, electricity, etc. Electrical and mechanical devices developed. Fee for amateurs \$5.00. Estimates on other service promptly furnished. Technical Information Service, 1415 Pitkin Avenue, Brooklyn, New York.

DOGS—BIRDS—PETS

RABBIT Hounds, Foxhounds, Coon, Opossum, Skunk, Squirrel Dogs, Setters. Circular 10c. Brown's Kennels, York, Pennsylvania.

EDUCATIONAL AND INSTRUCTION

LINCOLN-JEFFERSON University. Home study in Academy College, Theological, Law, Music, Pharmacy, Business and Graduate Schools, leading to degrees. Lock Box 239G, Chicago.

MATHEMATICS taught by mail. Spare time home study course, including arithmetic, geometry, algebra, and trigonometry. J. A. Harding, 76 Brighton Ave., Highland Park, Michigan.

MAILING LISTS

BIRTHS—deaths—marriages. Guaranteed lists. Ten dollars a thousand names. National Newspaper Reading Service, 296 Broadway, New York.

How I Improved My Memory In One Evening

The Amazing Experience of Victor Jones

"Of course I place you! Mr. Addison Sims of Seattle.

"If I remember correctly—and I do remember correctly—Mr. Burroughs, the lumberman, introduced me to you at the luncheon of the Seattle Rotary Club, three years ago in May. This is a pleasure in deed. I haven't laid eyes on you since that day. How is the grain business? And how did that amalgamation work out?"

The assurance of this speaker—in the crowded corridor of the Hotel McAlpin—compelled me to turn and look at him, though I must say, it is not my usual habit to "listen in" even in a hotel lobby.

"He is David M. Roth, the most famous memory expert in the United States," said my friend Kennedy, answering my question before I could get it out. "He will show you a lot more wonderful things than that, before the evening is over."

And he did.

As we went into the banquet room the toastmaster was introducing a long line of the guests to Mr. Roth. I got in line and when it came my turn Mr. Roth asked, "What are your initials, Mr. Jones, and your business connection and telephone number?" Why he asked this I learned later, when he picked out from the crowd the 60 men he had met two hours before and called each by name without a mistake. What is more, he named each man's business and telephone number, for good measure.

I won't tell you all the other amazing things this man did except to tell how he called back, without a minute's hesitation, long lists of numbers, bank clearings, prices, lot numbers, parcel post rates and anything else the guests gave him in rapid order.

• • • • •

When I met Mr. Roth—which you may be sure I did the first chance I got—he rather bowled me over by saying, in his quiet, modest way:

"There is nothing miraculous about my remembering anything I want to remember, whether it be names, faces, figures, facts or something I have read in a magazine.

"You can do this just as easily as I do. Any one with an average mind can learn quickly to do exactly the same things which seem so miraculous when I do them.

"My own memory," continued Mr. Roth, "was originally very faulty. Yes, it was—a really poor memory. On meeting a man I would lose his name in thirty seconds, while now there are thousands of men and women

in the United States, many of whom I have met but once, whose names I can call on meeting them."

"That is all right for you, Mr. Roth," I interrupted, "you have given years to it. But how about me?"

"Mr. Jones," he replied, "I can teach you the secret of a good memory in one evening. This is not a guess, because I have done it with thousands of pupils. In the first of seven simple lessons which I have prepared for home study, I show you the basic principle of my whole system and you will find it—not hard work as you might fear—but just like playing a fascinating game. I will prove it to you."

He didn't have to prove it. His course did; I got it the very next day from his publishers, the Independent Corporation.

When I tackled the first lesson, I suppose I was the most surprised man in forty-eight states to find that I had learned in about one hour, how to remember a list of one hundred words so that I could call them off forward and back without a single mistake.

That first lesson stuck. And so did the other six.

Read this letter from Terence J. McManus of the firm of Olcott, Bonyne, McManus & Ernst, Attorneys and Counselors at Law, 170 Broadway, and one of the most famous trial lawyers in New York:

"May I take occasion to state that I regard your service in giving this system to the world as a public benefaction? The wonderful simplicity of the method, and the ease with which its principles may be acquired, especially appeal to me. I may add that I have already had occasion to test the effectiveness of the first two lessons in the preparation for trial of an important action in which I am about to engage."

Mr. McManus didn't put it a bit too strong.

The Roth course is priceless. I can absolutely count on my memory now. I can call the name of most any man I have met before—and I am getting better all the time. I can remember any figures I wish to remember. Telephone numbers come to mind instantly, once I have filed them by Mr. Roth's easy method. Street addresses are just as easy.

The old fear of forgetting (you know what that is) has vanished. I used to be "scared stiff" on my feet—because I wasn't sure. I couldn't remember what I wanted to say.

Now I am sure of myself, and confident, and "easy as an old shoe" when I get on my feet at the club, or at a banquet, or in a business meeting, or in any social gathering.

Perhaps the most enjoyable part of it all is that I have become a good conversationalist—and I used to be as silent as a sphinx when I got into a crowd of people who knew things.

Now I can call up nearly any fact I want when I need it most. I used to think a "hair trigger" memory belonged only to the prodigy

and genius. Now I see that every man of us has this kind of a memory if he only knows how to make it work right.

I tell you it is a wonderful thing, after groping around in the dark for so many years to be able to switch the big searchlight on your mind and see most everything you want to remember.

This Roth course will do wonders in your office.

Since we took it up you never hear any one in our office say, "I guess" or "I think it was about so much" or "I forget that right now" or "I can't remember" or "I must look up his name." Now they are right there with the answer.

Have you heard of "Multigraph" Smith? Real name H. Q. Smith, of John E. Price & Co., Seattle, Wash. Here is just a bit of a letter of his that I saw last week:

"Here is the whole thing in a nutshell: Mr. Roth has a most remarkable Memory Course. It is simple, and easy. Yet with one hour a day of practice, any one—I don't care who he is—can improve his memory."

My advice to you is don't wait another minute. Send to Independent Corporation for Mr. Roth's amazing course and see what a wonderful memory you have got. Your dividends in increased power will be enormous.

VICTOR JONES.

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selling at new low levels wages are being cut and factories are closing in every section. In Detroit it is reported that the automobile plants laid off 100,000. In Akron the tire companies are running only 25 per cent of their capacity. In every city in the country, from Coast to Coast, people are working part time, or looking for work or accepting radical reductions in wages.

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The experimenters, however, were not so much interested in the problem in physics as they were in the problems in psychology. The thing they wanted to know was what made Ruth superior to all other ball-players in hitting power, rather than to measure that power.

Babe Could Beat His Own Record!

Before proceeding to the psychological tests, however, we tried another in physics to satisfy my curiosity. A harness composed of rubber tubing was strapped around Ruth's chest and shoulders and attached by hollow tubes to a recording cylinder. By this means his breathing was recorded on a revolving disk. He was then placed in position to bat, an imaginary pitcher pitched an imaginary ball, and he went through the motions of hitting a home run. The test proved, and the needle recorded, the fact that, as a ball is pitched to him, Babe draws in his breath sharply as he makes the back-swing with his bat, and really "holds his breath," or suspends the operation of breathing, until after the ball is hit. But for that fact, he would hit the ball much harder and more effectively than he now does. It has been discovered that the act of drawing in the breath and holding it results in a sharp tension of the muscles and a consequent loss of striking power. If Ruth expelled his breath before striking the ball, the muscles would not become tense and his swing would have greater strength and rhythm.

The first test to discover the efficiency of his psychophysical organism was one designed to try his coordination; a simple little test.

The scientists set up a triangular board, looking something like a Ouija-board with a small round hole at each angle. At the bottom of each hole was an electrified plate that registered every time it was touched. Ruth was presented with a little instrument that looked like a doll-sized curling-iron, the end of which just fitted into the holes. Then he was told to take the instrument in his right hand and jab it into the holes successively, as often as he could in one minute, going around the board from left to right.

He grew interested at once. Here was something at which he could play. The professor "shushed" me, fearing that I would disturb Ruth or distract his attention as he started around and around the board, jabbing the curling-iron into the holes with great rapidity. He would put it into the holes twelve to sixteen times so perfectly that the instrument barely touched the sides. Then he would lose control and touch the sides, slowing down. Only twice did he pass the hole without getting the end of the iron



A row of letters was exposed to view for one fifty thousandth of a second. The average person can note and read correctly four and one half letters in that time. But Babe Ruth read six out of eight letters

into it. With his right hand he made a score of 122. Not unnaturally, his wrist was tired and Babe shook it and grinned ruefully.

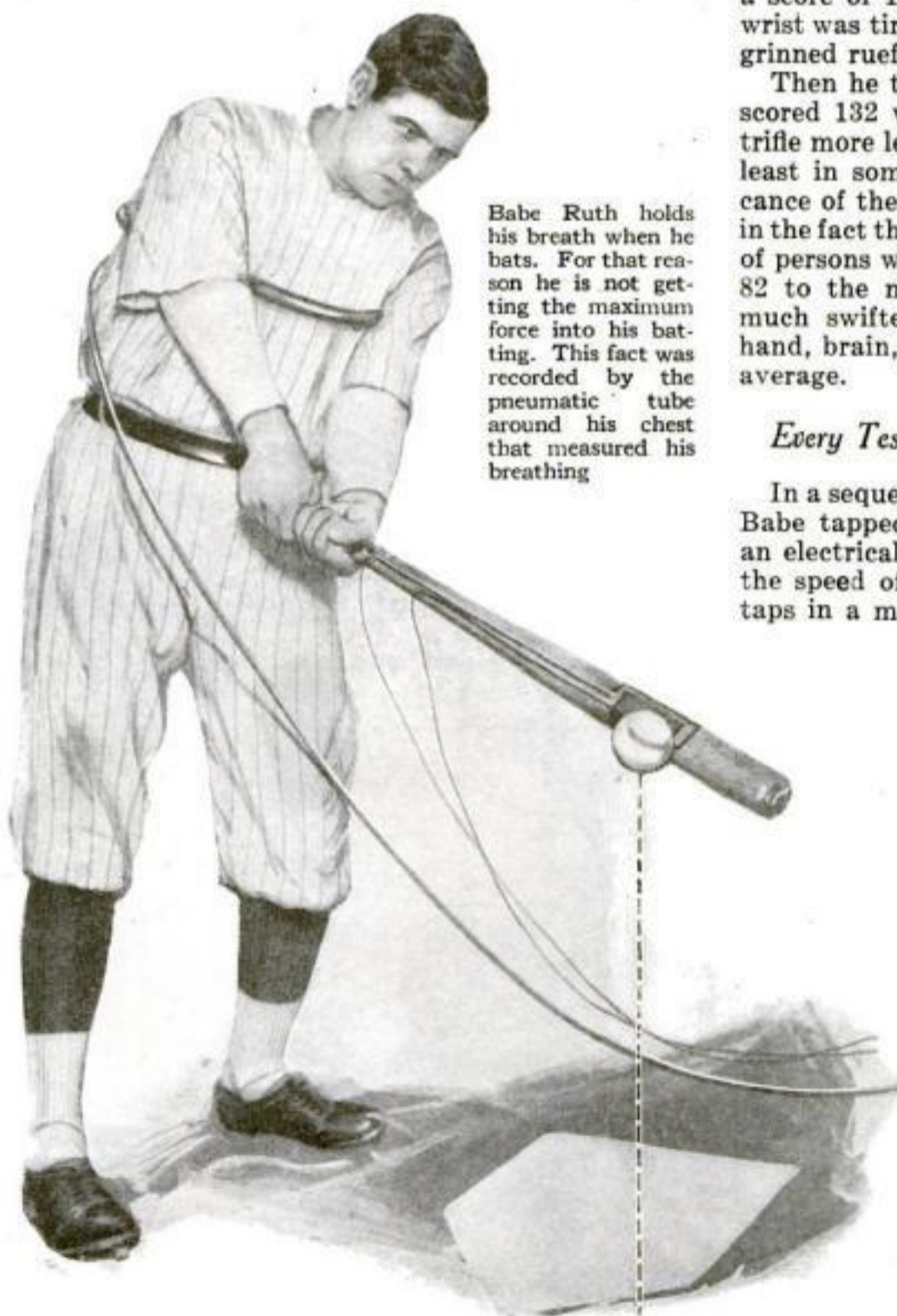
Then he tried it with his left hand, scored 132 with it, proving himself a trifle more left- than right-handed—at least in some activities. The significance of the experiment, however, lies in the fact that the average of hundreds of persons who have taken that test is 82 to the minute, which shows how much swifter in the coordination of hand, brain, and eye Ruth is than the average.

Every Test but Another Triumph

In a sequel to this test that followed, Babe tapped an electrified plate with an electrically charged stylus with all the speed of a drum-roll, scoring 193 taps in a minute with his right hand

and 176 with his left hand. The average score for right-handed persons undergoing this wrist-wracking experiment is 180, and, while there is no data covering right-handed persons using the left hand, it is certain that Ruth's record is much above the average, as he is highly efficient with the left hand.

But steadiness must accompany speed and so they tested the home-run king for his steadiness of nerve and muscle by having



Babe Ruth holds his breath when he bats. For that reason he is not getting the maximum force into his batting. This fact was recorded by the pneumatic tube around his chest that measured his breathing

Pitching Baseballs by Machine

THE automatic pitcher has arrived! A demonstration of this new "machine gun" of the diamond was recently given at the Polo Grounds, New York city. From a tank under the grand stand, compressed air is conveyed through a flexible tube to the "gun" in the field.

The automatic pitcher, regulated by a small spring on top, registers an "out drop" on the ball, and a piston-ring develops an "inshoot," while another mechanism throws out a ball that is moist. B. F. Blair, of Indianapolis, is the inventor.

The purpose of the device is not to displace the professional twirler. Its purpose is to save the energy of the pitchers who have to perform during batting practice.



With this automatic pitcher the batter can be served with an indrop, outcurve, or spitball. It saves the arms of the human pitchers in batting practice.



The great height of the Woolworth Tower gives it an extra hour of sunlight daily.

City Cliff-Dwellers Have Extra Daylight Hour

IN the highest skyscraper in the world the daylight lasts an hour longer for those living in the upper floors.

No matter what the law may be, these people are bound to be daylight savers.

When the sun sets behind the high ground on the western shores of the Hudson River, a well-defined shadow is cast for a little more than one mile on the faces of the skyscrapers on lower Manhattan Island. This shadow rises steadily at the average rate of one foot in a trifle more than two seconds. The amount of daylight gained by an ordinary building is negligible, but in the case of the world's highest skyscraper, the saving is surprisingly large.

The fifty-two stories of the Woolworth Building rise to a height of 792 feet, 1 inch. The shadow of the Palisades falling on the structure moves upward one foot in two and one half seconds, which means that the sun takes about thirty-two minutes to rise from the base to the pinnacle of the tower. In other words, half an hour after the streets are in shadow, one may take an elevator to the tower and still see the sunset.

Since the sun takes a corresponding length of time in the morning to climb down from the tower to the base, the daylight saving is approximately one hour.

Portable Circus Grand Stand

A LINE of circus wagons drives into the vacant lot and horses and elephants form them into a long column twelve feet apart. The teams are unhitched—and four minutes later a solid grand stand is set up.

Any old-time canvasman will tell you that it used to take two hours to erect a circus grand stand, so it is easy to appreciate how much the portable stands, invented by W. C. Curtis, superintendent of the Hagenbeck-Wallace Circus, mean to the traveling show. This grand stand is a combination of wagon and seat structure built together and unfolded on location. The wagons are built of six-inch channel iron, with heavy wheels and axles. The seats fold along the sides so that on the road the center of the cart is unobstructed and forms a service space for carrying other circus property.

All danger of accidents is eliminated, as all the planks are bolted down to their supports. The string-

ers are spaced four feet apart, instead of the customary seven feet of the standard traveling stand. The capacity of each wagon is about 280 seats. The units are flexible, to allow the stands to conform to any irregularity of the ground, and the connections on the wagon allow the seats to be unfolded, even when the wagon itself is twisted or sunk in soft mud.

Additional folding sections twelve feet in length, with a capacity of 112 seats, are placed between each wagon. The supports are two by six-inch spruce beams resting on swivel or self-lining bases to take care of any bad line-up in placing the wagons.



This view shows the grand stand as it appears unfolded and braced for use.



Four minutes after the portable grand stands arrive on the grounds, they are ready for the circus crowds.

OBSERVATIONS made by members of the United States Weather Bureau on Mount Wilson, California, show that ants move faster at high temperatures.

By timing the rate at which ants moved over a measured section of a trail, it was found that their speed varied uniformly with the temperature, and that in passing from cool shade to the full heat of the sun (a change of 54° F.), the same ant would increase his speed from 0.44 to 6.6 cm. a second.

Will This 300-Mile Bigger Bertha Make America Supreme in Future Wars?

The Temple gun, using every grain of powder, has a projectile speed of five miles a second

THE most stupendous progress in the concentration of explosive force since gunpowder was invented seven hundred years ago, is now declared by Dr. Miller Reese Hutchison to have been accomplished by Robert Temple, creator of the Temple gun.

Dr. Hutchison has made public demonstrations to prove that this American Bigger Bertha, so far existing in a miniature model only, focuses nearly all of the efficiency of explosives in the projection of its shell, compared with an average of 25 per cent in other big guns.

With these figures as a basis, experts predict that this new piece of ordnance will have a range of three hundred miles with a five-ton shell.

The Temple gun, he says, is noiseless and kickless, despite its terrific propulsive power. Its maximum shell velocity will be five miles a second.

In its present form, if used for riveting, the gun will drive a bullet half its length into a three-quarter-inch steel plate placed against the muzzle of the gun—with no shock or danger to the gunner or spectators. And Dr. Hutchison went ahead, in his office in the Woolworth Building, and astounded a group of scientific skeptics by shooting a few dozen bullet-rivets into a chunk of armor.

Were it not for the un-

questioned eminence of the engineer who sponsors the inventor, the announcement would be discredited as a hoax. The principle of the gun is being held secret for United States military use.

From 50 to 75 per cent of the explosive force of the high-power rifles is dissipated in the form of heat and sound. A big gun on a battleship belches forth a twenty-foot tongue of flame when it is fired. It is the direction of all this fierce energy back

of the projectile that nearly quadruples the power of the Temple gun. Nothing is wasted of the gun-charge, not even the roar.

As explained by Dr. Hutchison, every particle of

powder is burned in the Temple gun before the projectile starts to move under the impetus of the expanding gases. Thus the tremendous force of the product gases accumulates until combustion is complete, at which time the bullet is sent forth with a terrific push.

The law of action and reaction accounts for the "kick" of firearms—a great problem to ordnance and ballistic experts. The Temple gun has no recoil and produces no noise when its charge explodes.

The muzzle of the small



According to the figures of ordnance experts, by utilizing every particle of energy in the powder, a supergun built on the principle of the present small Temple gun could hurl a five-ton projectile across New York State from New York City to Rochester, a distance of 255 miles

Temple gun can be placed against a three-quarter-inch steel plate at the moment of firing. When the trigger of the gun is pulled, there is no kick and the only sound heard is a sharp click—the metallic crack of the impact of the steel bullet against the steel plate.

The penetration of the bullet into the steel may be regulated by alteration of the charge. Its range of velocities is from one to five miles a second.

The supergun will have its peacetime as well as its wartime uses. It may be pressed into service as a riveting device. The steel bullets will penetrate steel girders and beams rapidly and quietly. It may be operated under water in salvaging operations and a recent test showed that it was necessary to exert a force equivalent to eight tons before the steel bullet placed under these conditions could be withdrawn.



The gun in its present form at work as a riveting machine showing bullets that have been driven into the steel plate



As a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in Popular Science Monthly

Using the Vacuum-Cleaner Idea to Unload Coal

A unique electrically operated suction device that lifts sixty tons an hour to a height of fifty feet

By P. J. Risdon

English Correspondent, Popular Science Monthly

THEORETICALLY it is impossible to lift coal by vacuum. An ordinary hydraulic suction pump can only lift water about twenty-seven feet. How, then, can coal, which is far heavier than water, be drawn up nearly twice this distance? Whatever theory dictates, it can be done, for an equipment of this description is working daily on the docks of an electrical company at London.

As a matter of plain fact, it is not vacuum alone that accomplishes the deed. It is more a combination of vacuum and a column of fast-moving air. Air rushes in to fill a vacuum at a speed of nearly eight hundred miles an hour. If a heavy substance such as coal is placed in a blast of this terrific velocity, it cannot help being carried along. That is why the coal-unloader shown in the illustrations can handle pieces as large as four inches in diameter.

The Impossible Happens

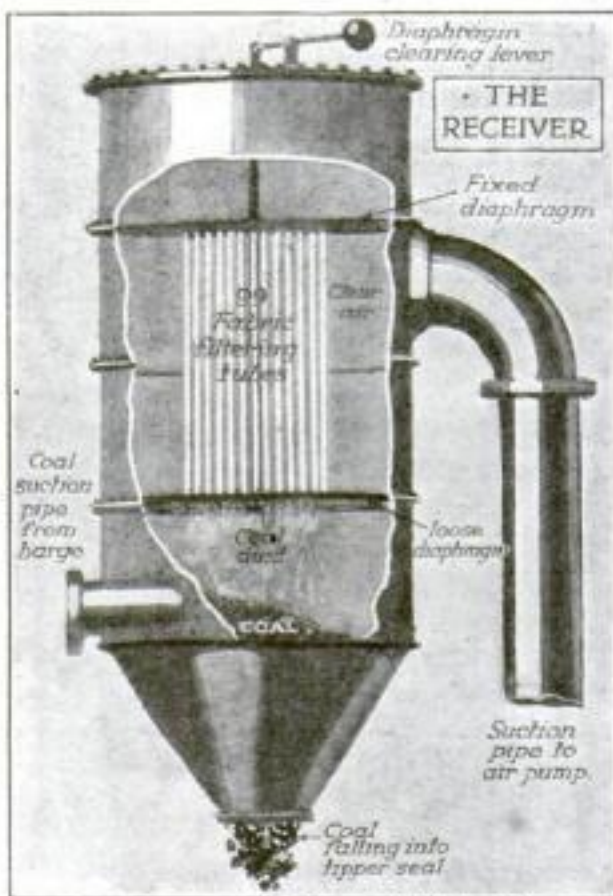
Although the vacuum provided is only twelve inches of mercury, the current of air generated is sufficiently powerful to partly drag and partly push the coal to the top of the fifty-foot tower. Unusually ingenious methods are employed to prevent the dust-laden air from clogging the suction pump. In fact, it was the solution of this particular problem that made the idea a practical success.

On the wharf is a tower sixty-five feet high, with a series of platforms at different levels. On the topmost platform is mounted a circular bin or "receiver," fifteen feet deep and six feet three inches in diameter, with a hopper-shaped bottom. From this receiver a twelve-inch-diameter steel pipe-boom extends outward over the water, the outer end being stayed by adjustable ropes from the top of the tower, so as to form a movable arm with a flexible joint at the tower end. From the end of the boom a nine-inch-diameter flexible piping, with an intermediate telescopic length, extends down the hold of a barge or collier, where it is attached to a "nozzle," the open end of which is pushed forward into the coal.

The middle section of the receiver, which is divided into three parts, is connected by means of a twelve-inch-diameter air pipe with a vacuum pump that exhausts the air from it, thus sucking up the coal from the

barge to the receiver, from which it drops on to the "tipper seal."

In the receiver is a set of ninety-nine vertical fabric pipes, known as "filtering tubes," through which the dust-laden air has to pass and in which the coal-dust is collected. At intervals



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The dust-laden air passes through these filtering tubes, which hold the coal-dust until the loose diaphragm is shaken to dislodge it.

this set of pipes is shaken, causing the coal-dust that has accumulated in them to fall into the hopper. This feature of the plant corresponds to the dust-bag on a vacuum cleaner, with the difference that air is forced through the fabric of the vacuum-cleaner bag, while in the apparatus under consideration, air is drawn through the fabric of the filtering tubes into the vacuum chamber. The object, of course, is that only filtered air shall reach the air-suction pumps.

The "tipper seal" beneath the receiver is a double-compartment, airtight box with a vertical partition, hinged in the middle to allow it to tip to and fro beneath the hopper. Both compartments are fitted with a door in the top and another near the bottom. Supposing coal from the receiver to have filled one compartment, the tipper seal is tilted by means of a belt-

driven crank and yoke. As it moves over, the top door closes, the lower door opens, and the contents are discharged into a hopper beneath the floor. Meantime coal from the hopper has filled the other compartment and the "tipper seal" is again tilted.

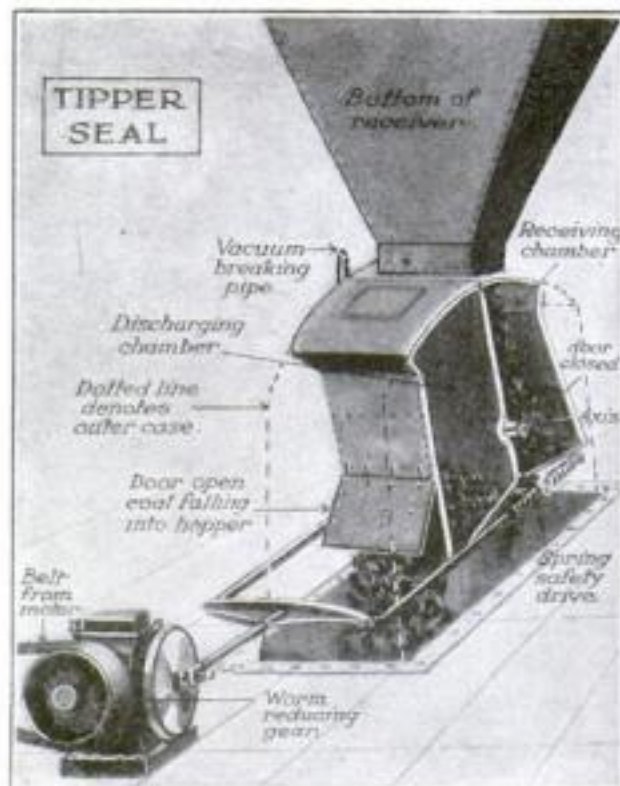
From the hopper the coal drops through a twelve-inch opening on to an endless belt, which conveys and discharges it into a storage bunker or into the coal-cars.

Sixty Tons Handled Every Hour

The "nozzle" is fitted with a door so that it can easily be cleared in case it becomes blocked. The nozzle-box is about three feet long, thirteen inches wide and eight inches deep, and the other parts of the apparatus are so proportioned that there is no fear of coal jamming elsewhere, once it is through the nozzle.

The vacuum is maintained by a double-acting air-suction pump, forty-nine inches in diameter, with a sixteen-inch stroke, and driven by a 125-horsepower motor. Sixty tons of coal an hour are handled by each of the two plants now at work.

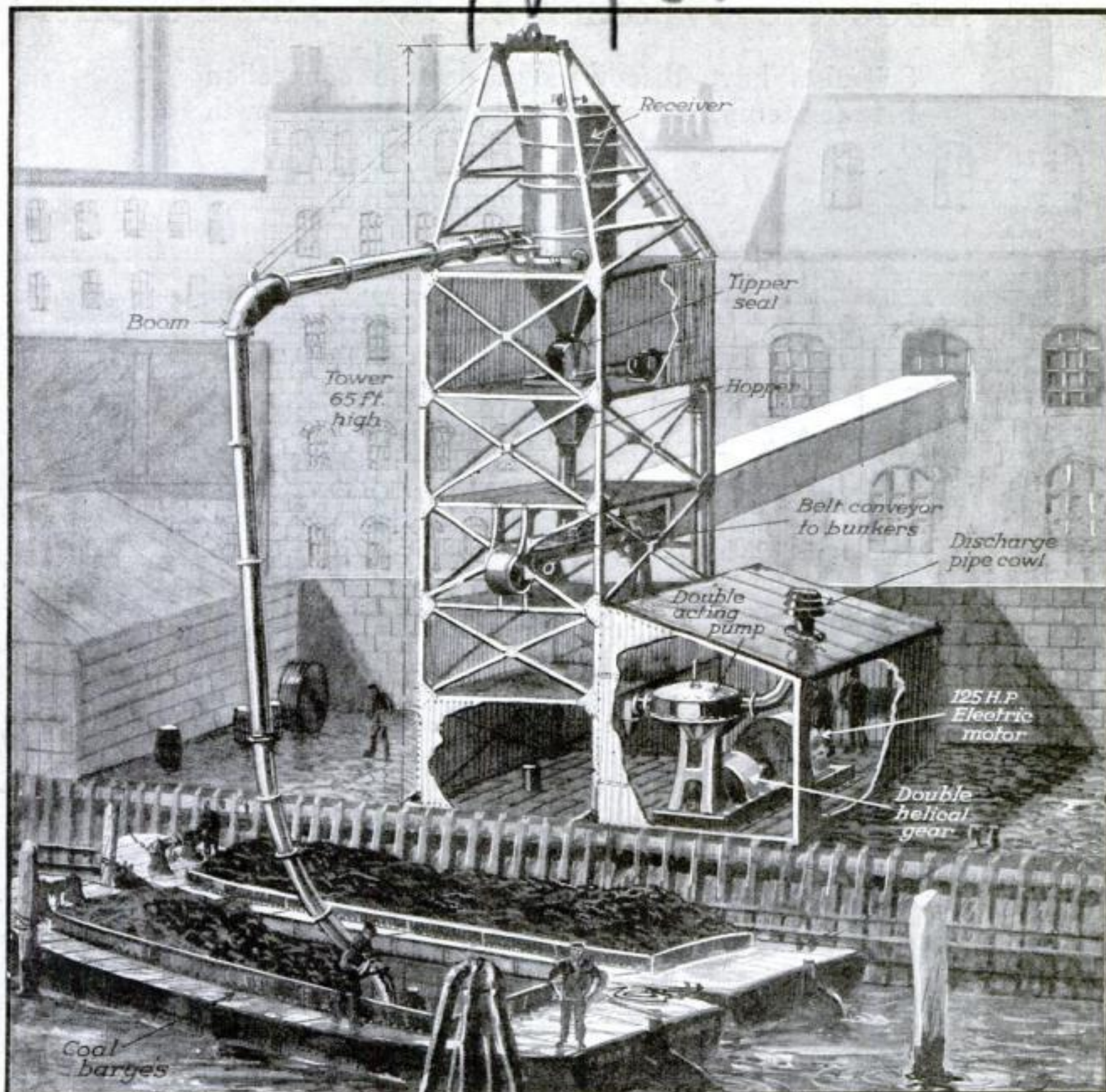
The cost a ton slightly exceeds that of unloading coal by grabs, but this expense is outweighed by other advantages of the vacuum process. The unloading is continuous and it requires few skilled men.



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While the coal is filling the sealed side of the receiving chamber, the other side is emptying into the open hopper. This "tipper seal" is necessary to hold the vacuum in the unloader.

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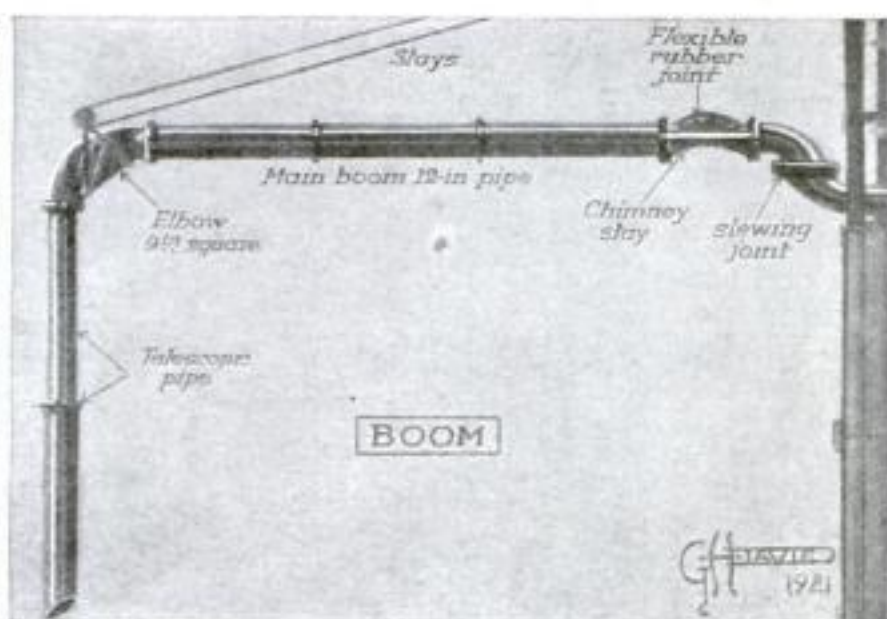
Drawn by G. H. Davis

A strong suction draws up the coal fifty feet to the receiving tank, where the coal-dust is filtered from the air and the coal dropped into the hopper. This method requires fewer men, empties the barge quicker and is particularly noticeable for its elimination of the coal-dust nuisance



© Modern Publishing Company

A workman feeds the nozzle into the coal-pile and a vacuum draws the coal up the pipe



Drawn by G. H. Davis

Freedom from sharp bends makes it possible to handle lumps of coal four inches in diameter

What Made the Weather So Hot This Summer?

Scientists have discovered a definite connection between temperature, sun-spots, and timber growth

By Henry D. Hubbard

United States Bureau of Standards

DO sun-spots upset our weather on earth? Was this past summer's heat-level made erratic by the sun-spots of the spring? Have abnormal solar disturbances flashed us a warning to lay in coal for an unusually severe winter?

One of the most fascinating scientific controversies of the day is developing around these questions, and while scientists do not agree that they can yet predict weather conditions from observation of solar cyclones, still they do consider the general question definitely answered. And they say that while the astronomer may read this answer in the heavens, he may also find it actually written on the pine boards of his observatory floor. Moreover, it is written there in characters that the amateur may read as well as himself.

The characters are markings on the faces and ends of the boards, traces of annular rings of the trees from which the boards were hewn. These "life lines" disclose not only the history of the trees and of our weather changes, but the climatic history of the sun.

Some time ago science found that our weather, as distinguished from our climate, is caused or initiated by changes in the radiant power of the sun, power that is increased during periods of solar turbulence, forming hot spots and sun-spots—cyclones on the sun—whirling hot gases hundreds of miles a second, shooting them a hundred thousand miles into space, and deluging our air with electrons from spot-craters, bringing interior solar heat to the

surface and developing restricted hotter areas on the sun's circumference. Then it found that there was an

tracing the effects of the rhythm on our weather conditions.

The search carried them far afield and finally brought them home again to their observatory floors, or, for clearer results, to the trees from which the floorboards were hewn.

The face and end of the board pictured on page 24 shows a rhythm of growth that corresponds to the sun-spot rhythm—eleven years. Scientists, examining innumerable tree-ring cycles, have found the same thing—maximum growth occurring during maximum sun-spot years, slighter growth during years when solar turbulence was in abeyance.

"So," says science, without generalizing too hastily, "there must be something at spot-times that favors tree growth," and Professor Andrew E. Douglass, of the University of Arizona, and others are at work trying to solve the tremendous problem of how solar cyclones, ninety-two mil-

lion miles away, can exert such magic over tree growth on the earth. That they exert magic on the earth in other directions seems proved by our recent

experience with brilliant auroras and electrical disturbances which, last summer, cut off telephone and telegraph service, played high jinks with magnetic compasses and interrupted electrical power service.

At sun-spot times the solar surface is made hotter, our air cooler, rains abound, ultra-violet rays are scattered and the red rays, so useful in plant growth, are strong. The testimony of the tree rings seems to bring the final proof that

(Concluded on page 28)

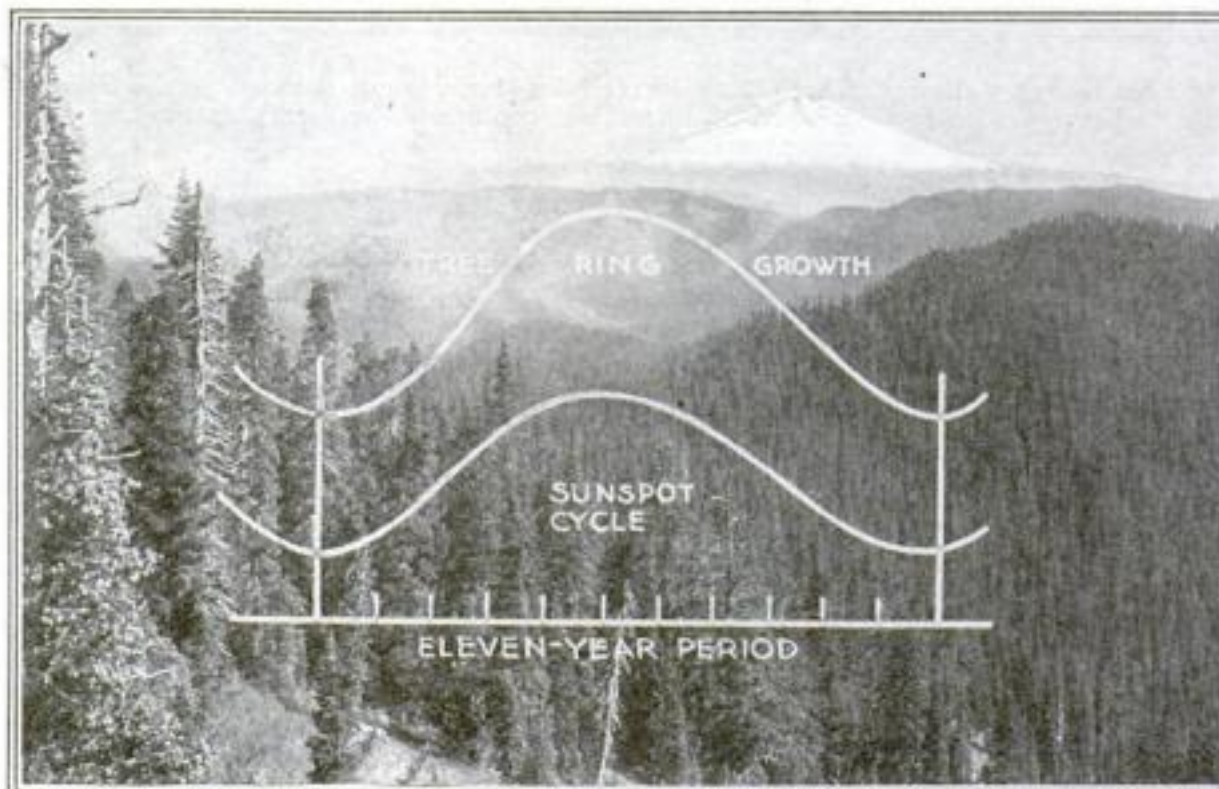
Can We Blame It on the Sun-Spots?

A SUMMER of unequalled drought in Europe—the Thames drying up; London's water supply threatened; Paris blinded by a hot spell unprecedented in fifty years; Switzerland baked by the sun until its lakes shrunk; such drought in parts of the United States that farmers appealed to traveling rainmakers.

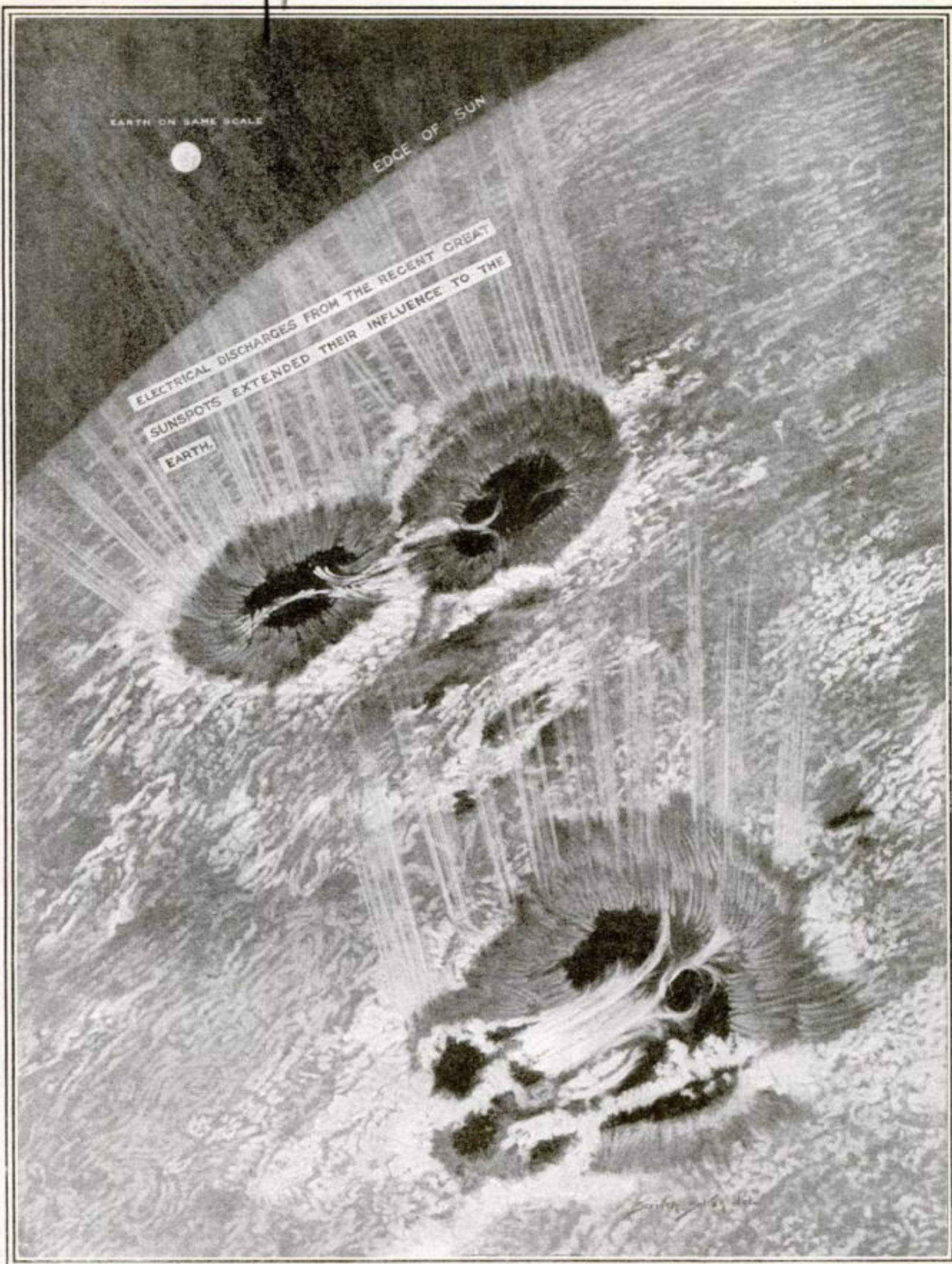
These abnormalities of the spring and summer afflicted the earth in a sun-spot year. Perhaps there was no connection between sun-spots and the heat. But human comfort, convenience, and efficiency are so much affected by intemperate weather that any indication of such connection, making long-range weather prophecy feasible, is of interest to all.

You will find in this article remarkable evidence of direct relationship between solar cyclones and earthly weather disturbances.

eleven-year rhythm of sun-spots—a long ebb and flow in the tide of solar activity—and recent efforts of astrophysicists have been directed toward



The upper curve indicates variation in tree growth over an eleven-year cycle; the lower curve shows the sun-spot variations over the same period, suggesting that vegetative growth on earth is affected by the recurrence of storms on the sun



© Illustrated London News

What Sun-Spots Really Look Like and How They Bombard the Earth

It has long been known that the activity of sun-spots varies over an eleven-year cycle, but it was only recently that scientists connected this fact with the varied growth of timber.

Just as the "life rings" of trees determine their age, so it is possible to tell from the same rings the years in which sun-spots have had their greatest effect, for in the years when swirling storms in the sun's atmosphere have been most severe, the trees

have shown the greatest growth; that is, every eleventh year.

In looking backward, it is noted that the presence of violent sun-spots occurred coincidently with remarkable electrical and magnetic storms on the earth. By charting the location and magnitude of the spots, it is possible that weather forecasters will be in a position to predict accurately changes in atmospheric conditions many weeks before they take place.

there is nothing coincidental about all this.

A striking example of how the sun writes its chronicle on wood is shown in a sector of the ring growth of one tree cut in 1912. Count back a ring a year to the 1882 ring—the thickest ring growth in seventy-six years of this tree's life. Now, 1882 was a sun-spot maximum year. On April 16, alone, thirty new sun-spots were formed, 116 sun-spots were counted, flashing auroras were seen that night, and earth currents observed by which telegrams could be sent from Omaha to New York without batteries. For nine months of the year 1882 the most brilliant comet of the century was visible on its flight around the sun, with a tail two hundred million miles long. Certainly, the coincidence of the largest tree ring, the greatest comet, and the sun-spot maximum is more than accidental. A sector of this tree shows the eleven-year periods, but the reader may find as good examples in his board fence or kitchen floor.

But in some trees the sun-spot cycle is obscured. Volcanic dust may mask the effect by scattering sunlight. The tropical tree rings are less marked, and while some regions appear to respond promptly to solar changes, others seem to lag.

It must not be thought that the solar changes affect the weather in a single, simple manner. The relation must be disentangled gradually from



A piece of a packing-box shows the variation in tree growth and the eleven-year cycle of greatest development. The studies have been made by the American Museum of Natural History

conflicting factors. Increased heat at solar maxima may actually cause a cooler year on the earth's surface, somewhat as a grate fire may heat the face and cause a cold draft on the back. But scientists have declared that the sun-spot maximum coincides with the East Indian cyclone seasons and with the West Indian hurricane maximum as well, and recently Professor Pickering, of Harvard, solely from drought and sun-spot records, predicted the 1919 to 1920 drought in Jamaica that spread such disaster through the West Indies.

The sun-spot cycle has been known

since 1851, but not until lately has its importance to us been so clearly traced. There is another cycle, a short-term cycle, created by the rotation of the sun, which brings the recurrent effects of its spots or its superheated areas to bear on the earth once every twenty-six and a half days. This cycle has actually been made the basis of a system of forecasting.

Recall for a moment the eighty-thousand-mile chain of sun-spots first seen on the eastern edge of the sun at the equator on May 8, 1921. As they neared the center of the sun's disk, violent magnetic and electric storms began on the earth. Auroras were observed, large earth currents reported, and magnetic forces changed so rapidly that record was impossible. The large spot seen toward the end of 1919 was observed for many months rotating with the sun. At each rotation, as the spot passed central on the disk, auroras were seen on the earth that culminated in the display of March 22, 1920.

There is a brilliant climax to this. As these sun-spots rotate with the sun, the great shafts of superheat that they throw out rotate with them. In turn they strike each plant in their pathway. Thus, the planets may be signal lights flashing natural weather signals of solar pulses before the sun's rotation brings such shafts of superheated areas in line with the earth.

Your Character Is Indicated by Every Breath

A NEW science by which a man's character can be determined by X-ray studies of the movements of his diaphragm in breathing has been perfected by Dr. Maingot, of Paris. The subject is placed in front of a large radioscopic screen and his breathing charted by the operator, and after a long series of observations, Dr. Maingot declares positively that as a man breathes, so is he. The salient features of the character may be deduced without possibility of deception, since the movements of the diaphragm are largely involuntary.

Phrenoscopy, as this character science is called, takes into account the general appearance of the thorax, the beating of the heart and of the aorta, as well as the breathing movements. All of these factors may be readily observed with a large X-ray machine, and all are characteristic.

For example, the subject is ordered to breathe deeply. If the diaphragm obeys immediately, the man is of a docile temperament, and if the respirations continue for a long time

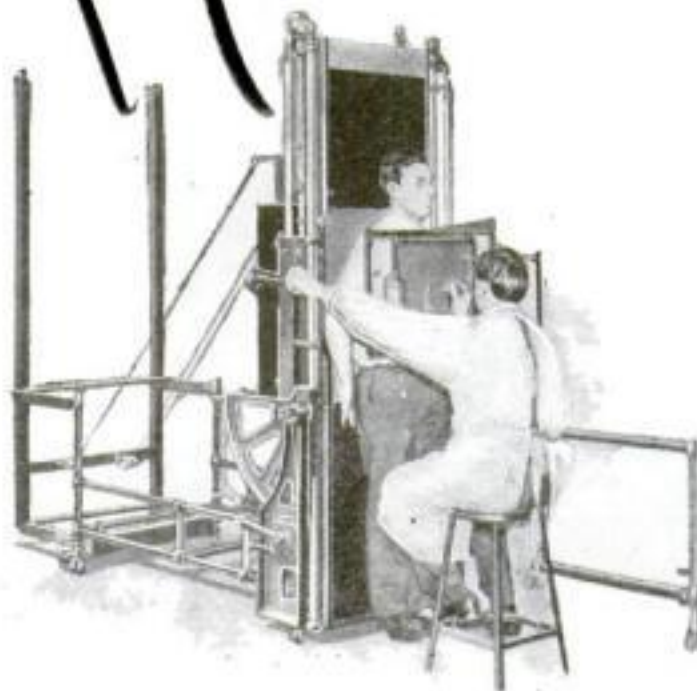
at the same intensity, he is persevering. If the response to the order does not take place immediately, it indicates that the man is reflective, and weighs the consequences of his acts before performing them. The firmness with which the diaphragm contracts at the end of the respiration

discloses the man's tenacity of purpose. If expiration succeeds inspiration instantly, the man is mentally alert and probably a quick thinker.

Moreover, the diaphragm does not remain in the same shape during the breath movement. If it alters very little, so that it moves up and down like the piston of a steam-engine, the man is exact, calculating, and fitted for success in business. On the other hand, the artistic temperament is disclosed by a diaphragm that moves in waves, changing its shape with every breath.

The value of character study by phrenoscopy lies in the fact that it enables a man to learn just what his fundamental character is, and for what general line of work he is best fitted.

While it is virtually impossible for a man to change his character, he may readily modify it and make the most of his natural, inborn abilities, and it is from a desire to assist a young man in choosing his life work intelligently that Dr. Maingot has developed phrenoscopy.



This instrument reveals your mental character, your temperament, how you rest, and how you work

Are Modern X-Rays a Public Danger?

Powerful emanations that penetrate brick walls and lead screens may injure persons in neighboring regions

By G. Contremoulins

Chief of Principal Radiographic Laboratory of the Paris Hospitals

IN April, 1896, five months after the discovery of X-rays—or Röntgen rays, as they are also named, in honor of their discoverer—a pose of eight hours was required for a correct radiograph of a profile head, the tube being placed ten inches from the sensitive plate.

In April, 1921, a similar image was obtained in four hours at a distance of ninety yards from the apparatus. This means that the radiation with modern apparatus is more than twenty thousand times stronger than was possible in 1896.

With the very weak radiation that I have used for my experiments, corresponding to the ordinary radiographic and radiosopic work, it has been easy for me to obtain images of metallic objects and human bones placed on a sensitive plate fifteen feet from the radiating source, although the rays passed directly through a slab of marble an inch thick, a sheet of lead one tenth of an inch thick, and a flooring eight inches deep, built of oak boards and rough plaster.

Rays Penetrate a Twenty-Inch Wall

Fifty feet from this same source I have been able in four hours to fog a photographic plate placed behind a wall of brick and stone twenty inches thick. Also in the same time I have obtained a correct radiograph of a skull and a crab, two hundred and sixty-two feet from the X-ray machine. All these experiments were made with a seventeen-centimeter spark and two milliamperes of current.

If photographic plates are so

readily affected by these rays, we must admit that animal cells also are affected to an appreciable degree. The X-rays that are being used to cure a patient may at the same time inflict radiodermatitis on other persons exposed to their influence in adjoining rooms or buildings. Nothing will suffice for safety but to cover the walls and floors of X-ray rooms with sheets of lead from a quarter to half an inch thick, according to the power of the source and its distance from the lining.

As an experimenter from the very first discovery of the X-rays, beginning in February, 1896, I shall probably end in the manner of my late associates, but at least my own experience may benefit others. I was able, up to the war, to direct my laboratory at the Necker Hospital without having received injury. Research work with foreign bodies carried on during the

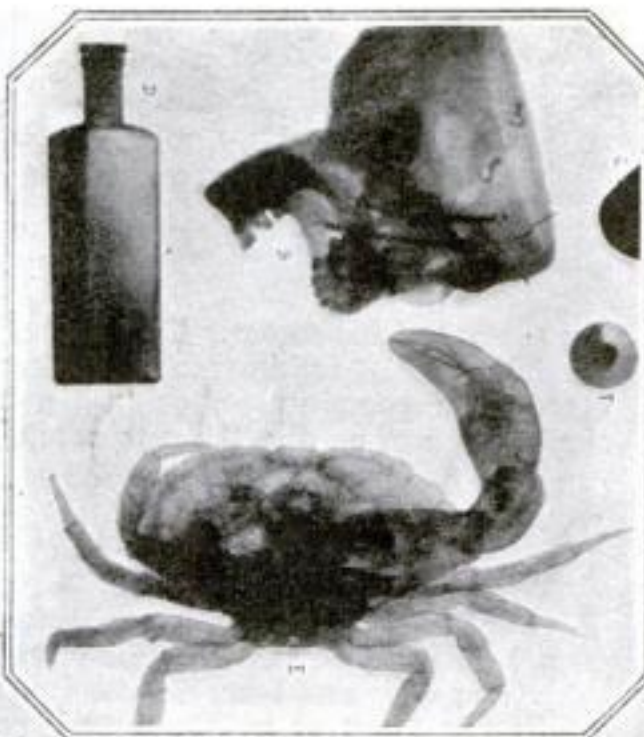
war with army material, which allowed no efficacious protection, has given me inflammation of the skin of my hands, justifying my fears.

Biologic reactions from X-rays take two forms. The first is a skin lesion known as radiodermatitis, caused by the skin absorbing a large quantity of radiations. The second results from the improvements in X-ray tubes and the use of filters absorbing the radiations of long wave length, currently named "soft radiation." This reaction takes place deep beneath the skin upon the active cells that are the most vulnerable. It is principally the internal secretion glands that are affected. Among those who continually receive even weak doses, a gradual lessening of vitality takes place, leading slowly to a physiological impoverishment that inevitably carries them off sooner or later.

How Protect from the X-Ray?

The problem of suitable protection is becoming a serious one. It is no longer a question of 70,000 to 90,000 volts in action, but of 200,000 volts under three milliamperes. And when we reflect that recent investigations in the treatment of cancer show the necessity of twelve to fifteen hour radiations with extremely penetrating rays, we must ask with anxiety what will happen to innocent people in neighboring parts of the building.

The employment of such X-ray energies, considering their potential harmfulness, should be regulated by the authorities along with other "dangerous occupations."



© Kadel & Herbert



X-ray radiations, after traveling 262 feet and passing through several buildings, were still powerful enough to produce the radiograms shown above. The dotted line in the lower illustration shows the path of the rays

First the Movies; now the "Talkies"

Films accompanied by speech are the latest development in motion-pictures

ALMOST since the introduction of motion-pictures, inventors have been trying to synchronize the projection machine and the phonograph.

"Make the screen figures talk," some one at one of the early performances said, "and you will double the value of the photoplay."

"The Talkies," recently presented for the first time, are the result of the research work and experiments of Orlando E. Kellum, of Los Angeles.

Mr. Kellum was satisfied to progress slowly with his invention, and he was plugging away in his shop while others were rushing into the market with machines and methods that were little better than make-shifts. The others have been forgotten, but apparently the Kellum machine is here to stay.

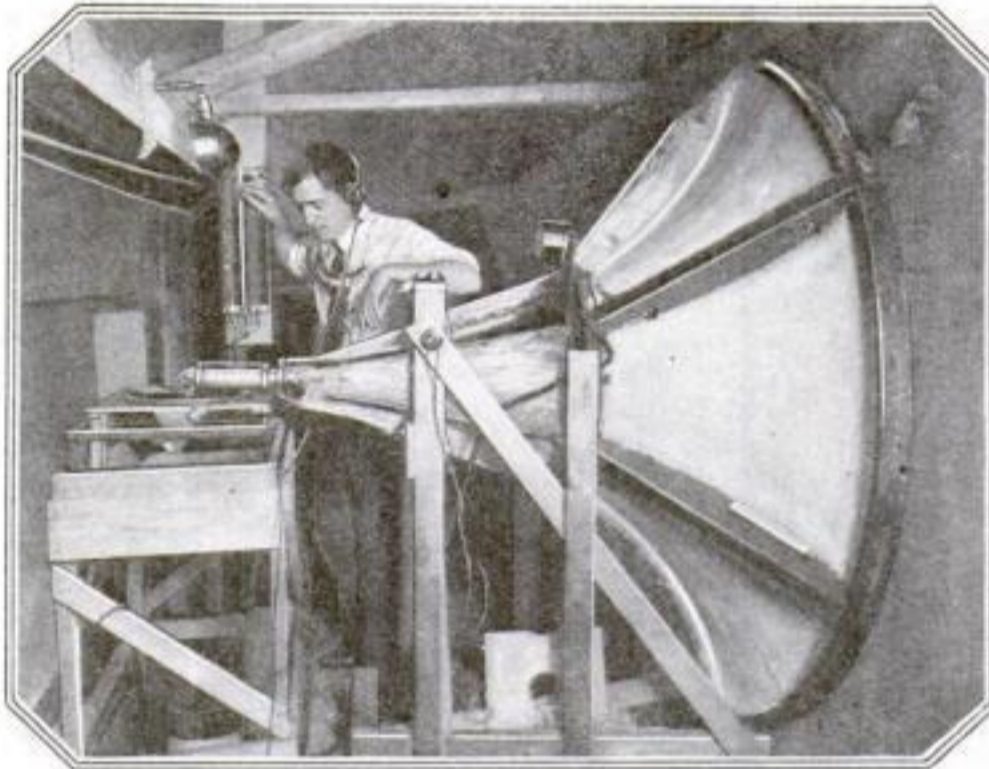
The Kellum timing system is automatic and electrical. It synchronizes pictures and talking-machine as perfectly as is necessary. All other methods involved the cleverness of the operator in charge of the projection machine. He had to correct defects in the timing by speeding up or slowing down the projector, as the case might require. The human element in the control made perfect synchronization impossible and it was not uncommon to see figures walk off the screen while the phonograph was still delivering their lines.

To operate the projection machine in perfect time with the phonograph, Mr. Kellum decided he would have to use a motor that would combine extreme lightness, low running speed, and a minimum of inertia, combined with a tendency to start the instant the current was turned on and stop the instant it was cut off. Also this motor, inasmuch as there can be no gradual speeding up of either phonograph or projector, would have to be capable of starting at top speed.

The inventor did not attempt anything new in motors. He remembered the cast-off solenoid motor. This motor was discarded because it possessed the very qualities later sought in a motor for the timing of the talking "movies." In it there was no heavy coil revolving. The only moving part was a plunger of iron that was drawn

into and expelled by a hollow coil as the current was turned on or off. Mr. Kellum made a motor similar in form and operation to the multi-cylindere d gasoline engine. Each cylinder was a hollow coil and in place of the engine's gastight piston was a plunger. The plungers transmitted motion to a crankshaft that in turn was geared to the projection machine.

Next the inventor provided for



The specially constructed phonograph that includes a commutator to regulate the speed of the projection machine

the control of his motor. To a large, specially built talking-machine, he attached a commutator, or "timer" similar to those used on the automobile

engine. Wires led from it to the six-cylindere d motor, each cylinder of which "fired" in proper order as it received current through the collector rings of the commutator. The phonograph was thus put in control of the entire system, passing out current for one motor coil at a time and thus causing the motor crankshaft to revolve and turn the film through the projector.

Motion-picture producers already see in the "talkies" a new field in educational work. It will be possible to use them for "canned" lectures as well as for scientific demonstrations in which the film will show the action while the phonograph will reproduce the scientist's explanation.

With its aid, also, the farmer may take advantage of illustrated "talks" on scientific farming no farther away than his own town hall.

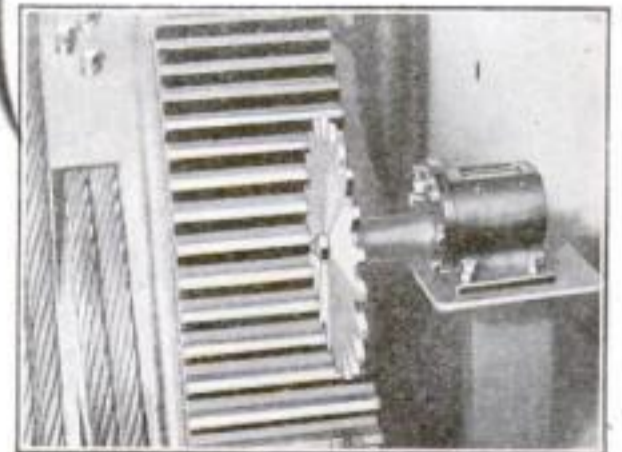
Keeping Tab on a Hauling-Cable

INASMUCH as the hauling-cable in a hoisting plant is the part most subject to wear and tear, it should be checked at frequent intervals. Wear and tear depend mainly on the bending stresses occurring at the guide pulleys and the winch-drum, and, in a given plant, apart from the average load, on the actual number of bends undergone by the cable—that is, in the distance traversed by it.

Comprehensive tests, made by G. Benoit, afford the data required for ascertaining in a given hoist or elevator the admissible distance after traversing which the cable should be exchanged.

The picture illustrates a handy attachment for recording the work of hauling-cables. It was designed by a German electrical concern, and is arranged to record in kilometers the

upward and downward travel of the cable. It is enclosed in a water-tight base, with ball bearings on its main axle.



This instrument records in kilometers the distance traveled by hoisting-cables. Renewals can then be made at regular intervals

What Do You Want to Know? Send Your Question to Popular Science Monthly

An Information Service for readers who want the facts

WHAT is basalt? A French inventor claims to have discovered a process by which it can be melted and converted into the hardest known paving-blocks. Would you like to know about this process?
Ask Popular Science Monthly.

How does a gas-meter work?
What are sun-spots?
Do you know how to detect impure ice-cream in the home?
Is the X-ray really dangerous to use?
Where have talking-movies been shown?

Perhaps some definite question, concerning these or other subjects mentioned in this issue, has been puzzling you.
What is that question?
Let Popular Science Monthly answer it for you.

THE man who learns more is the man who earns more. The man who gets ahead is the man who acquires concrete, usable knowledge about the scientific processes and problems that he meets in his business and in his home. The most valuable learning is that obtained by finding out the answer to each question as soon as it comes to your attention.

If you can't find the answer yourself, let the Scientific Information Service of Popular Science Monthly help you.

The following are answers to typical questions received by our Information Service:

What is the food value of an alligator pear?—E. A. G.

It is an unusual fruit in that its flesh has a high fat content averaging 20.1 per cent. The avocado, as this fruit is more rightly called, contains about 70 per cent water, 7 per cent carbohydrates, and has an average fuel value of 984 calories to the pound. Its high protein content, as compared to other fresh fruits, places it far in the lead in this respect. The avocado is easily digestible and has a high food value.

I have noticed that weather reports give rainfall to a fraction of an inch. How is this done?—P. W.

The government makes use of a special device for this purpose. It consists essentially of a fairly deep vessel with straight sides, out of the bottom of which a funnel leads into the measuring-cup. The principal precaution is to see that the vessel is placed in an open space so that rain can neither be blown into nor out of it.

What is the average weight of a human brain?—S. O'B.

A man's brain weighs about 50 ounces; a woman's brain about 44 ounces.

What is considered to be the quickest method of getting up steam?—M. K. S.

According to the Bureau of Standards, the quickest way is by a device similar to the "flash boiler," which is used in

some makes of automobiles. This boiler exposes a very small quantity of water to intense heat generated by gasoline, kerosene, or an oil-burner, and the water is converted almost instantly into steam. A "flash boiler" will generate a full head

and the moon is low, all rays but the red rays are absorbed by the atmosphere.

Why was the Dead Sea of Palestine given its name?—W. R. S.

Because it contains no life whatsoever.

At a depth of a thousand feet the water of this sea contains 27 per cent of solid substances. The presence of chloride of magnesium gives the water a bitter taste and chloride of calcium is responsible for the oily appearance and feel.

Is there a large amount of salt in sea-water?—N. D.

One hundred parts of sea-water will contain on the average 3.5 per cent of solid material, of which the greater part is sodium chloride or common salt.

What substances besides water and tar preparations can be used on driveways and highways to keep down dust?—E. B. L.

Calcium chloride, if applied in flake or powder form just before a rain, is a good dust-layer. Crude sulphite fluid sprinkled over the roadway will also prevent the dust from

rising. One or two applications a season of the latter mixture will be sufficient.

I have heard X-rays spoken of as "Roentgen rays." Are they the same thing?—H. E. W.

Yes, the use of either term is proper. These rays were discovered by Professor Roentgen and were called by him "X-rays" from the mathematical term x , which signifies an unknown quantity. Later, as an honor to their discoverer, they were given the name "Roentgen rays."

What is asbestos and where does it come from?—R. F. S.

Asbestos is one of the non-metallic minerals. It appears as a fibrous rock, often mixed with other minerals. The asbestos most commonly used is white or gray in color, but it is also found in blue and green mixtures. Its principal property is its resistance to fire and acid, but it is also widely used as an electrical insulator. The leading asbestos mines are in the Province of Quebec, although it is found in almost every country.

WHATEVER your problem in general science, the Information Service of Popular Science Monthly stands ready to help you solve it.

On account of the large number of questions received, it is necessary that each one be made as clear and specific as possible. Replies will be made by mail. The most interesting questions with their answers will be published monthly in the magazine. It will be impossible, of course, to answer questions requiring extensive research or those demanding more complicated explanations than can be given in a letter. Medical and legal questions cannot be answered.

A stamped, self-addressed envelope must be enclosed with each inquiry.

Address your letter to The Editor, Popular Science Monthly, 225 West 39th St., New York.

of steam from cold water in two or three minutes.

I have been asked to find out if it is possible to bleach an ivory hair-brush that has turned yellow. Is there a solution to do the work?—G. O. V.

Ivory may be whitened by washing in a solution consisting of an ounce of nitric acid and ten ounces of water. Apply the solution with a rough brush. Another method is to rub the ivory with fine pumice and water and while damp expose to the sun under a glass vessel. If the nitric acid solution is used, be sure to rinse the brush thoroughly in clean water.

Sometimes when the moon is near the horizon it appears much larger than at other times and it is frequently red in color. Can you tell me the reasons for this?—C. T.

The moon seems of exaggerated size when near the horizon because your judgment is unconsciously affected by earthly objects within the field of your vision. When the air is thick or misty

Odd Items of Scientific Interest in the News

Australian Bandit Makes His Own Armor

NED KELLY, leader of a desperate gang of Australian outlaws, would have been successful as an iron-worker. Out of a few plates of stove iron he made a suit of armor that enabled him to withstand for a time a deadly rain of bullets poured upon him by troops and policemen.

Kelly began his career as an outlaw forty-three years ago. He was first a sheep-stealer, then in 1878 he shot a constable. There were four other members of his gang, including one woman. The great round-up occurred when the gang was surrounded in a hotel. The building was set on fire.

When the police and troops had decided that all the gang had perished, out of the burning ruins trod Kelley clad in his armor. With a revolver in each hand he succeeded in killing



Land Waterspout Sucks Up an Automobile

IF stories like this were common, it would become a regular thing for overland motor tourists to equip their cars with anti-waterspout anchors. A waterspout on land? Yes, this is what a cyclone moving over a lake amounts to—and the tonnage of water it sets into aerial revolution is colossal.

When Albert Giesecke was driving his heavy touring-car near Gulf Creek Pass, Colorado, he noticed a whirling black cloud, the lower portion of which formed itself into a twisting conicopia that viciously sucked in instead of benevolently pouring out. It raveled erratically across the surface of a small mountain lake on the shore of which Mr. Giesecke was driving with a load of passengers. The flood of water traveling at fifty miles an hour, caught the car, lifted it like a shingle, and tossed it over a precipice. Two people were killed and Mr. and Mrs. Giesecke were seriously injured.

Waterspouts at sea frequently wreck small sailing-vessels, and the largest of liners avoid them. A waterspout inland tears a little water from the surface over which it skims, but the bulk of the water borne by the whirling wind is caused by sudden condensation of the saturated atmosphere over a body of water. There is little truth in the stories of ponds having been sucked dry by waterspouts. The water-saturated air over the ponds supplies nearly all the churning flood. This is proved by the fact that the water in spouts at sea is always fresh.

IN Honolulu there are eleven separate national languages, forty-nine Japanese dialects, seven Chinese dialects, and English, which have to be understood by phone operators. This babel of tongues caused the company to appeal for an increase in rates.

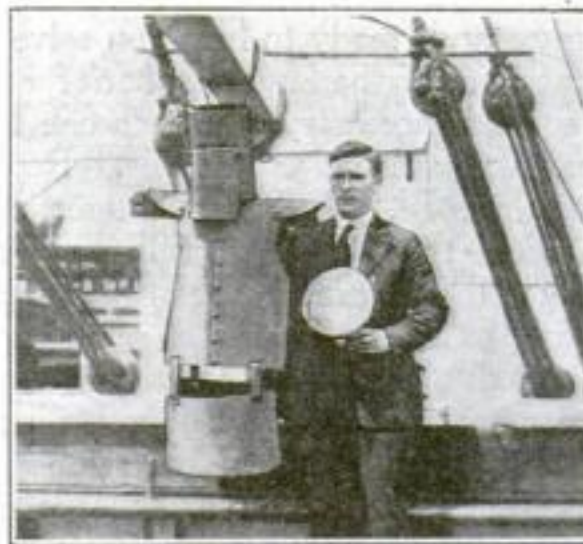
Plane Landed in an Extinct Volcano—and Escaped

WHEN his engine went dead in midair, Raymond Fisher, a pilot of the Forest Service, was forced to land on a tiny island in the center of Crater Lake, Oregon. This lake is in the crater of an extinct volcano and is surrounded by cliffs a thousand feet high.

Fisher found his plane was undamaged, but that four spark-plugs on the engine were broken. He realized that the only way to escape from his predicament was to get new spark-plugs and to fly out the way he had come, but it was almost impossible to reach him except by air, and there was no room for another plane to land on the island. How could the plugs be delivered?

He used his plane's wireless outfit to inform another flyer of his mishap. The latter flew to Medford, Oregon, and secured several sets of plugs. To each set he attached a small parachute. The rescue plane then flew as low over the island as the cliffs would permit and released the parachutes. One package landed on the island. Fisher found it, repaired his engine, and flew away safely the next morning.

This rescue suggests that with suitable detaching devices parachutes may be used by airplanes in flight to make rapid delivery of sorely needed articles. Mail-planes could drop letters to the smaller towns they pass over on their route. Metropolitan newspapers might be delivered to suburban stations a few minutes after press-time. Emergency medicines could be carried to ships at sea. Indeed, if several squadrons of planes were available, they might even supply a district suddenly isolated by flood, as Pueblo was last spring, with food and medicine. Small communities cut off by forest fires might also be supplied with tools for fire-fighting.



Adapting ancient customs to his need an Australian bandit made himself this suit of armor

several of his enemies before he was at last shot in the arms and legs, the unprotected portions of his body.

There are numerous bullet-marks on the metal, which was unpenetrated by them. Modern rifle bullets would have easily pierced the armor.

Cows Thrive on Sawdust

HYDROLIZED sawdust as a part of the ration for cows is giving satisfaction—at least, the cows are keeping up their weight and milk production, and show no ill effects from the diet.

In the experimental station that is run by the agricultural department of the University of Wisconsin, the proportion of sawdust has recently been increased from one fourth to one third the ration.

Up to the present time, all stock feed has been manufactured from white-pine sawdust by a special treatment with water, but other woods will be tried in the future.

A Ribbon of Hammered Gold

GOLD leaf, once employed to adorn the statues of the ancient gods and to color the brilliant insignia of medieval pageantry, is used today chiefly to ornament the modern plate-glass shop-windows with signs. Gold leaf is so thin that it takes about 400,000 leaves to make a stack one inch thick.

The gold-beaters' art has passed through the centuries practically unchanged. The work is still done by hand. Unsuccessful attempts have been made to employ mechanical methods.

Any sort of old gold is melted in a clay crucible. If the gold-beater suspects there are any impurities in the metal, saltpeter and corrosive sublimate are dropped into the molten gold to remove them. Borax is always put on top of the metal to keep it from adhering to the crucible.

How the Ribbon Is Made

The gold is poured into an ingot mold. The ingots are put through two polished steel rollers. Two workmen keep the gold continually passing between the rollers, gradually adjusting them until a ribbon of gold about two inches wide and twenty-five feet long, and one eight-hundredth of an inch thick has been made.

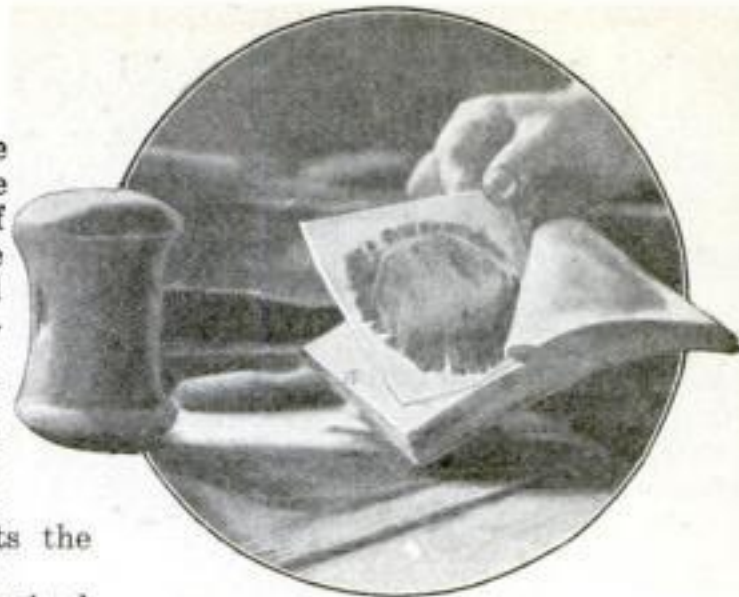
This strip is cut into two hundred pieces, each of which is placed between vellum leaves enclosed in a parchment cover and is pounded by hand with a twenty-six-pound hammer. The elasticity of vellum and parchment gives the hammer a rebound which makes the work less tire-

By Latimer J. Wilson

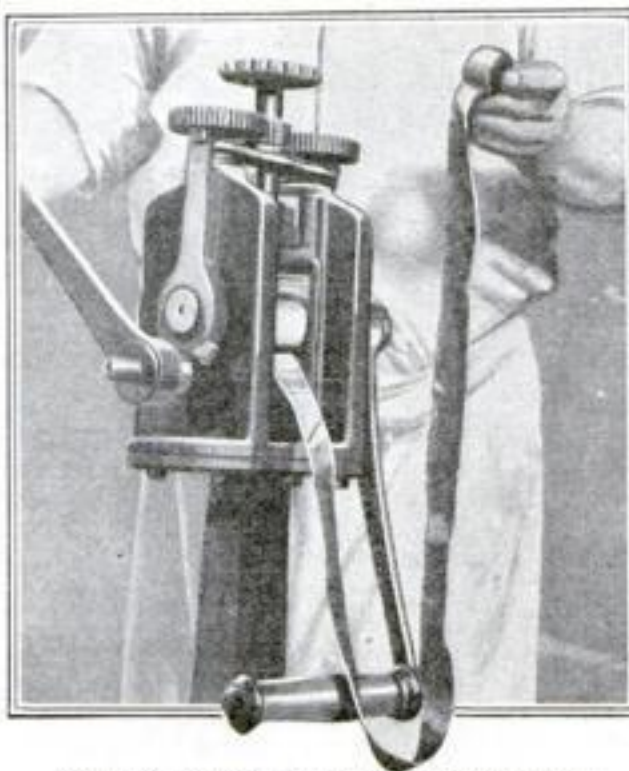
some. When the small squares have

been beaten to the dimensions of five and one half inches, they are each cut into four and placed between the leaves of tissue obtained from the skin of the intestine of an ox. Each leaf of the second book is of double thickness and has been dusted with powdered alum with a rabbit's-foot duster. This prevents the gold from adhering to the tissue.

Thus from the original two hundred there are now eight hundred pieces to be beaten. A lighter hammer is employed, and the squares are pounded until they have expanded to nearly



The small square of gold is pounded until it expands to nearly the size of the leaf of the beater's book



A gold nugget is placed between the rollers and is pressed into a twenty-five-foot ribbon. This is the only machine used in gold-leaf making

the size of the tissue leaves. They are then removed and again cut into four sections, now making thirty-two hundred small squares. Each of these is put back between the tissue leaves of the book and beaten again until expanded to five and one half inches. The heart of each leaf in a square of three and three eighths inches is then cut out and placed in a paper book as finished gold leaf.

Alloys Are Used for Color

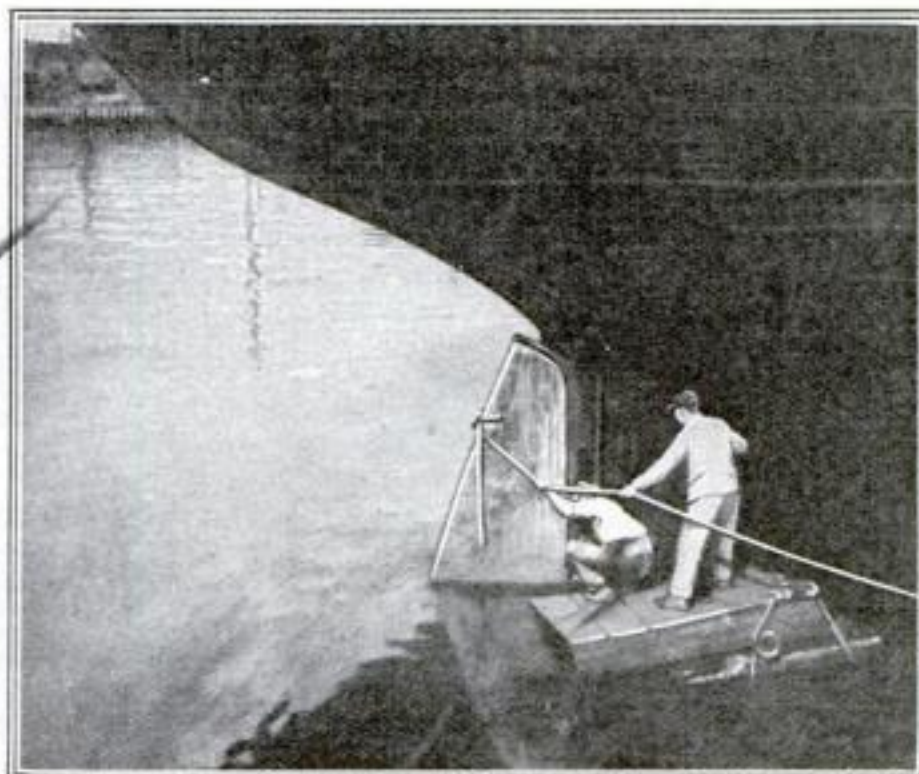
Twenty-two-karat gold is usually the quality employed in gold leaf, though there is enough variety of alloys to obtain light or dark colors. The trimmings are all put back to be recast into ingots.

Each perfect gold leaf is blown out flat upon the paper leaf of a book to be sold to the sign-gilder. It is scrutinized for imperfections and a magnet is held over each leaf to pick up any particle of iron which might have drifted in the air.

Schooner's Rudder Fitted without Drydocking

A LARGE rudder was fitted recently on the schooner *Alvena* while the vessel lay at her dock and without interrupting the loading of cargo. Such a repair usually requires drydocking and special equipment, but the *Alvena's* new rudder was "shipped" by clever rigging of the ship's own lines and hoisting equipment.

A line was rove from one of the hoisting winches on deck through the hole in the vessel's stern into which the rudder-post fits and was secured to top or stem of the rudder as it lay on the dock. Spring lines leading outboard and forward on each side of the ship were made fast to the bottom of the rudder, and



These ingenious jackies fitted a new rudder while their ship was loading. It's usually considered a drydock job

it was then pushed off the dock and simply and easily floated into place.

The top was hoisted until the stem was well up in the hole in the stern, and by taking up on the spring lines the crew was able to drop the lower part into the end bearing.

Two men standing on a raft next inserted the wooden lock-block that prevents the rudder from becoming unshipped. The top of the stem was then coupled to the steering-wheel, and the job was complete.

To those familiar with drydock charges, not to mention lost cargoes while the vessel lies idle, this achievement of the *Alvena* will be appraised at its true value.

New Wireless Receiver Types Incoming Message

Automatic printing telegraph adapted to radio use translates dots and dashes into letters, taking a hundred words a minute

WIRELESS messages can now be received and automatically type-written at the rate of a hundred words a minute. The printing telegraph in connection with land wires is comparatively familiar and is in general use by newspaper offices. With the new invention the same speed, convenience, and accuracy can be used for wireless despatches.

The recording device is the smaller machine at the right of the illustration. A paper tape is kept moving under a punch at a constant speed. A specially designed and highly complicated system of thermionic-valve or audion amplifiers is used by which the feeble wireless signals are stepped up into a current strong enough to operate a relay actuating the punch. This relay is constructed so that a hole will be punched on the right-hand side of the paper strip when the impulse begins, and on the left-hand side when it ends.

A Morse dot is recorded by two holes, one above the other, or nearly so; when the two holes are inclined one to the other, it represents a dash. Since the paper tape moves at a constant speed, the proper spacing between the dots, dash, and letters is reproduced.

As fast as it is punched the perforated tape is fed to the printer letter by letter in front of a series of ten pairs of selecting needles. One needle of each pair is connected to a series of ten slide-valve plates, each of which can be made to occupy one of two positions. A number of different combinations is thus provided, every one of which opens one complete and particular passage through the ten slide-valve plates. Compressed air can thus be admitted to any one of a number of small cylinders, each containing a piston that operates a typewriter key. The most astonishing part of the mechanism is the arrangement by which air is admitted to the proper cylinder at the right moment.

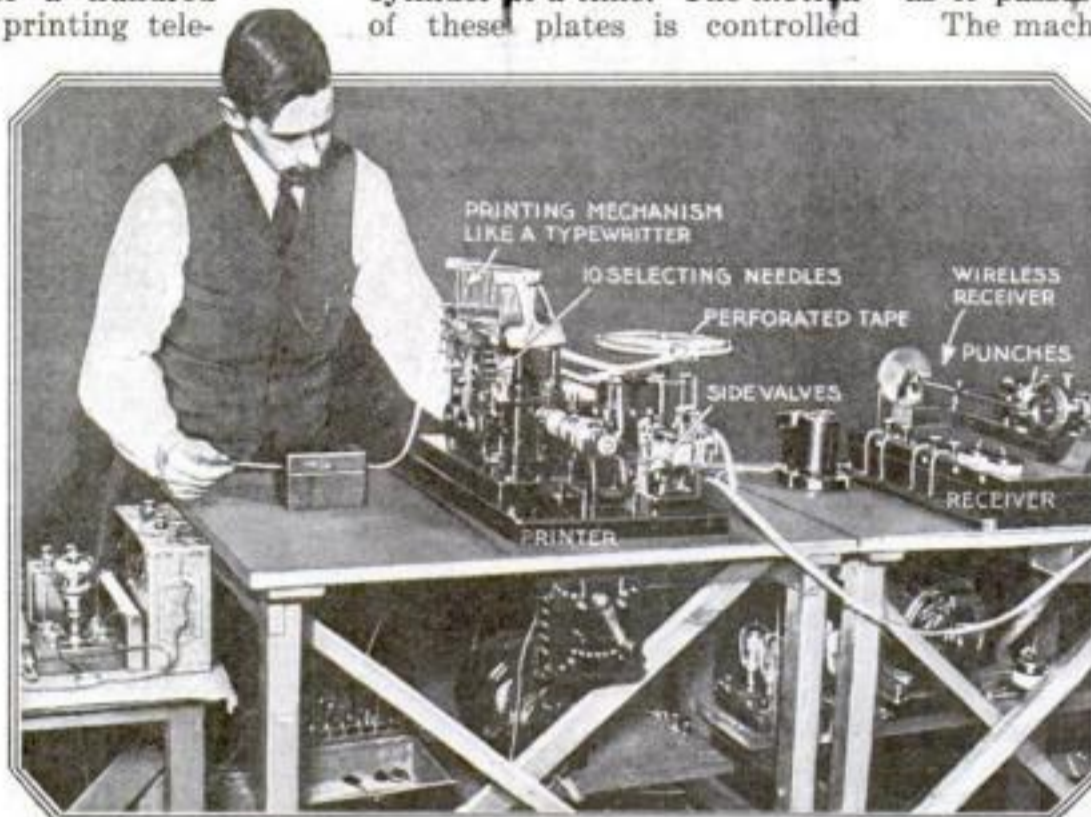
This is effected by the sliding, perforated plates, which form a very elaborate system of multiplex slide valves controlling the access of air to

the whole of the cylinders, but which will admit the pressure to only one cylinder at a time. The motion of these plates is controlled

by the needles, which are constantly feeling for the perforations in the tape as it passes by.

The machine has a "memory." For example, if three dots come along, it will print "S." But if it gets a further signal beyond these three dots, it must "remember" them while it waits to see whether the additional signal is going to be a dot or a dash. If the former, it will print "H;" if a dash, "V." Thus for any letter denoted by more than a single signal, the machine must "remember" all the dots and dashes that have preceded in order to know what letter to print.

Since wireless messages are sent out on specified wavelengths, this machine can be set up in the home.



You don't have to know the Continental code to receive on this wireless set. All the operator need do is adjust the wave length to that being transmitted by the sending station. The machine then prints off the message on a typewriter

Bulletproof Limousine for Chinese Governor

IN less than a minute the massive limousine shown below is transformed into an armored car; steel shutters slide in front of the glass windows, rifles nose out of the sides and back of the car, and a machine gun appears on the dashboard. In this fashion does Tsan Tso-Lin, Governor-General of Manchuria, protect himself against assassins.

The glass windows of the limousine are made of bulletproof glass; thus if a shot is fired before there is time to slide the steel shutters in place, the governor will still be safe. The shutters are operated by metal handles inside, as shown in the picture to the right.

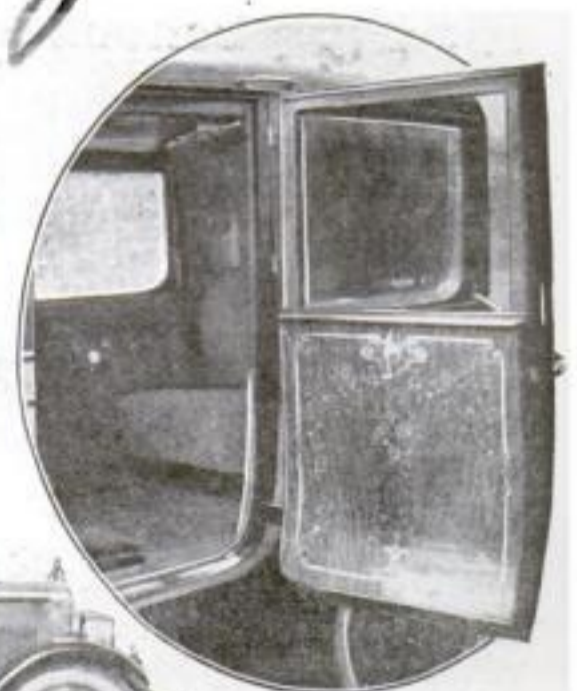
On each side of the car there are three belts and three corresponding handles; these are to accommodate soldiers, who can,

thus fight from the steps of the car.

In addition to being a safe vehicle, the governor-general's limousine is a very gorgeous one. It is upholstered in gold and purple mohair. The fittings are of mahogany and silver. The car was built in the United States.



Tsan Tso-Lin's limousine cleared for action, steel shutters up and rifles and machine gun in position



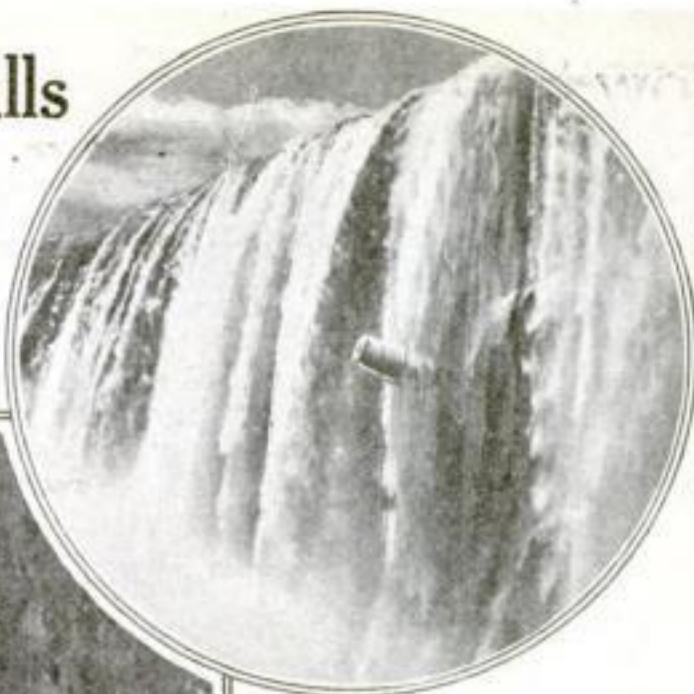
These gorgeous fittings camouflage fortress protection. The handle in the middle of the door panel controls the steel window-shutter

Playing with Death at Niagara Falls

Historic exploits of men who have shot the falls and rapids and lived to tell the tale

1935/4

© Underwood & Underwood

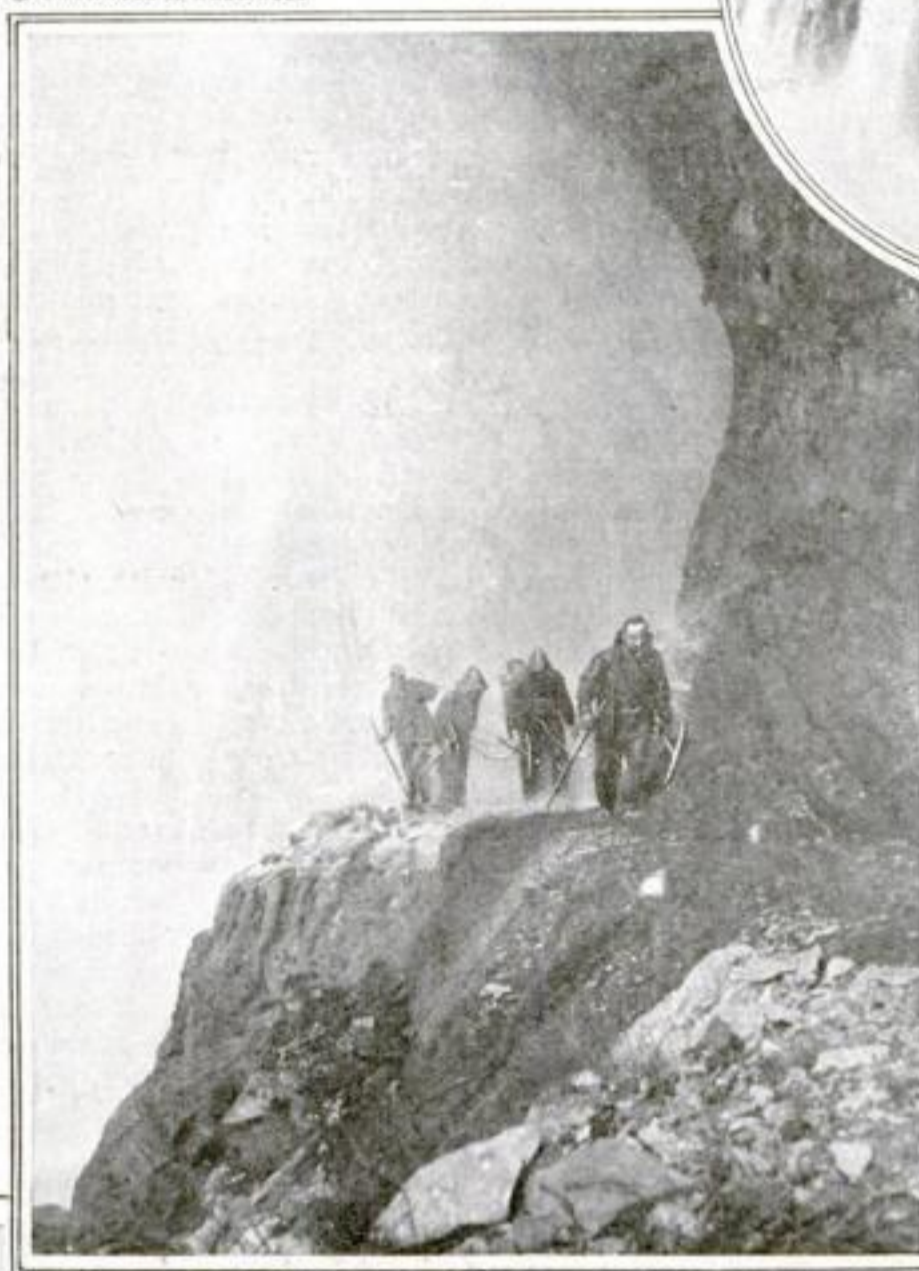


"Whirlpool navigators" going over the falls in a specially strengthened, long, narrow barrel, padded on the inside and weighted at the lower end. Five people, one a woman, have run the gauntlet of Niagara safely by this means



© Underwood & Underwood

The famous Blondin crossed and recrossed above the falls on a tightrope. He took a stove in a wheelbarrow to the center and cooked and ate his dinner in midair. He even crossed with baskets tied to his feet, and carrying his manager strapped in a harness on his back. This in 1859



Five men, roped together for safety, clambered along the face of the cliffs directly under the American falls and placed the last charge of dynamite to open the power penstock in the center, half-way from the bottom. The speed of the current leaves a small air space between the falling water and the face of the cliff, but the slightest mis-step by any of the party would have meant death for all five



Captain Larsen shooting the lower rapids in 1913, traveling from the foot of the falls to Lewiston. He made the trip alone. His boat was an ordinary cabin cruiser, made watertight and provided with buoyant compartments for the feat. The smallness of the craft placed it very much at the mercy of the current



Jack Robinson piloting the steamer, *Maid of the Mist*, from the falls to Lake Ontario, June 6, 1861. The first wave carried away her stack, but, traveling at forty miles an hour, buffeted by cross currents until it was impossible to steer, she passed every rapid and whirlpool in safety. The trip took fifteen minutes

How Sensitive Is the Human Touch?

Finger-tips aid the micrometer to detect an error of one hundred thousandth of an inch

DO you know that the nerves in your finger-tips will measure differences of a thousandth of an inch? That they can actually check up on the accuracy of a micrometer? Sometimes differences ranging from one ten thousandth to one one hundred thousandth of an inch are perceptible.

In fitting mechanical parts, the accuracy with which the nerves in the finger-tips will record small differences in dimension depends on various factors. The human equation and the thickness of the skin affect the delicacy of touch to some extent, and so does the size, the weight, and the roughness of surface of the object felt. Ordinarily, with small objects up to a pound or so in weight and a few inches in length, a discrepancy of a thousandth of an inch will be readily detected. Under proper circumstances, however, it is possible to exceed this figure. When the surfaces are polished and of small size, as with small steel balls, the fingers will notice differences of a hundred thousandth of an inch.

A method of demonstrating the sensitiveness of touch is given in the illustration above, which shows a machinist-micrometer and a thin aluminum handle, in which a steel ball is set at each end. In a well-made

By C. A. Briggs

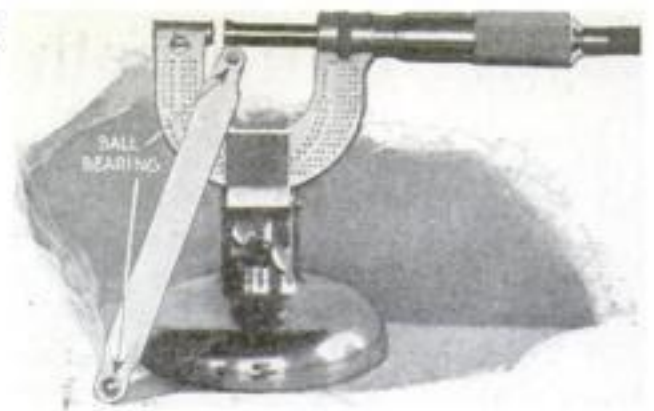
micrometer the faces on the spindle and the anvil are flat and perpendicular to the axis of the spindle, with an accuracy of between one ten thousandth and one one hundred thousandth of an inch. With a micrometer that is new or in good condition it is possible to adjust the distance between the measuring faces so that the aluminum probe will just be held in place.

How Touch Is Used

On experimenting, it will be found that when a change is made in the setting of the spindle corresponding to less than ten thousandth of an inch, a very perceptible change will take place in the friction with which the probe is held. It will either drop from between the jaws entirely, or be held with considerable force. There is no difficulty in subdividing the reading by determining the zones where the friction with which the probe can be moved is greater or less by a certain definite amount. This can be done very definitely; in fact, the boundaries of the zones can be confined to a narrow curve corresponding in breadth to less than a tenth of the distance between the measuring faces of the micrometer, which means a reading of a hundred thousandth of an inch.

It is possible to hang the probe between the jaws so lightly that the expansion produced by applying the finger for five seconds to the inside of the C-shaped frame opposite the jaws will cause the probe to drop out. It represents a change of something like a hundred thousandth of an inch, or less, in the distance between the jaws.

The more solidly the machine



Micrometer, and probe used for testing it, by means of which differences of 1/100,000 inch can be detected

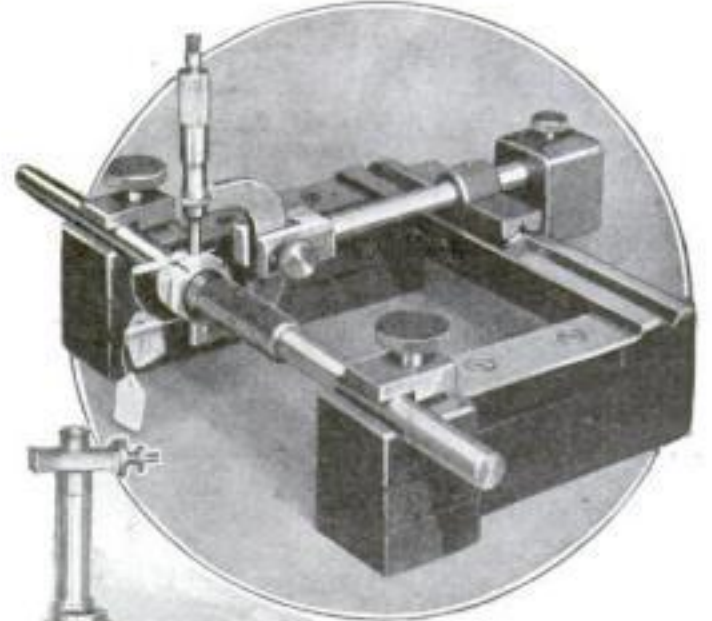
is built, the more pronounced the effect. A flexible or flimsy arrangement is not capable of giving the same spectacular results that can be obtained from a heavy, massive construction which looks as if it would support a locomotive.

It is necessary, however, that the jaws of the micrometer be highly polished and in perfect alignment, otherwise, although the probe may slip, it will not fall out entirely.

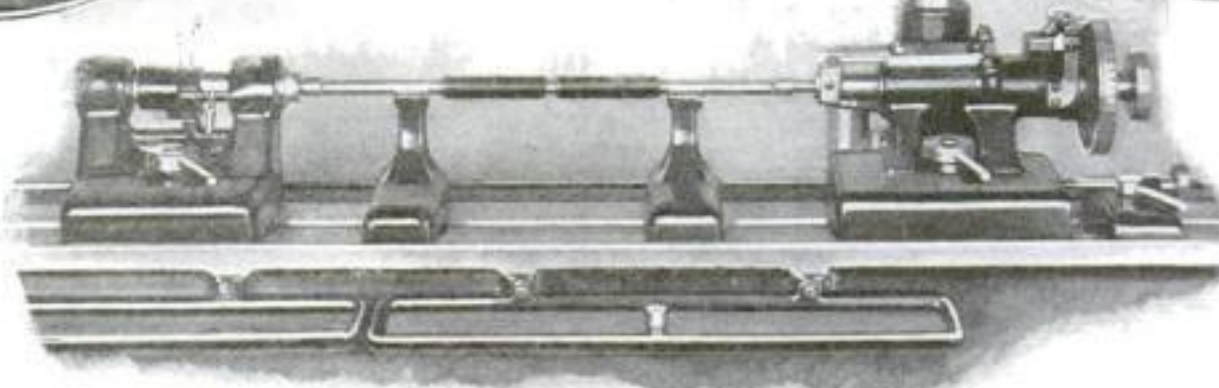
From these facts it should be clear that a high degree of accuracy in the construction of scientific devices may be secured with very simple tools. One capable instrument-maker employs simple calipering devices in making journals and bearings on theodolites, but by working by touch on the highly polished surfaces he is able to get the bearings within one one hundred thousandth of the same diameter, as is evidenced by the results obtained when the theodolite is tested.



Using the device for measuring the pitch diameter of screw threads. The "feel" of little wires that rest in the V of the thread guide him in getting the correct micrometer reading. This is bringing measurement down to a fine "pitch" indeed



A device for measuring the pitch diameter of screw threads. The jaws of a micrometer make contact with small wires which rest in the V of the thread. The proper setting of the micrometer for the reading is determined from the feel of the wires



Precision measuring machine. One end of a small plug, which can be seen at the left, is held between two vertical jaws. When the proper setting of the measuring screw is obtained, this is indicated by the fact that the pressure on the plug is relieved so that the plug drops toward a vertical position

Shooting Bears with Bow and Arrow

ON a recent hunting expedition into Wyoming to obtain specimens of grizzly bear for a habitat group for the California Academy of Sciences, Dr. Saxton Pope and Mr. Arthur Young, of San Francisco, decided to kill the bears with the bow and arrow. They used yew bows, pulling seventy-five pounds, and steel-head arrows.

Accompanied by a guide and armed with a rifle to be used in case of emergencies, after considerable search they discovered and stealthily approached four grizzly bears. Going over the brow of a hill, they surprised the beasts at a distance of twenty-five yards. They shot two with arrows and started a general fight among the bears. Suddenly a wounded female saw the archers and charged, coming with incredible speed. The guide shot her, breaking a foreleg. She tumbled backward down the hill, and, while making a second charge, was killed by two arrows that went through her body. A second bear was already dead with an arrow in the lungs.

After three weeks, the guide

and the rest of the party returned home, leaving Dr. Pope and Mr. Young to shift for themselves.

They discovered the tracks of an enormous grizzly, and built a blind on the side of a steep canyon near where he came to feed. After watching for many cold nights, a female bear and three young cubs appeared on the moonlit trail below them. Young and Pope shot at the cubs and the female charged them. She was hindered in her attack by fallen trees and steep ground, thus giving time for one of the archers to shoot her at a distance of less than forty yards. The



Mr. Young shot this thousand-pound bear with bow and arrow



This bear charged the hunters as they shot at her cubs, but a steel-tipped arrow pierced her heart before she reached them

arrow struck her in the right side and killed her.

At this very moment a monster grizzly appeared on the scene, wild with rage. The hunters discharged several arrows at him at a distance of sixty yards. Much to their disappointment, the bear loped off. Later, they trailed him by his blood. They found him where he had fallen over a cliff.

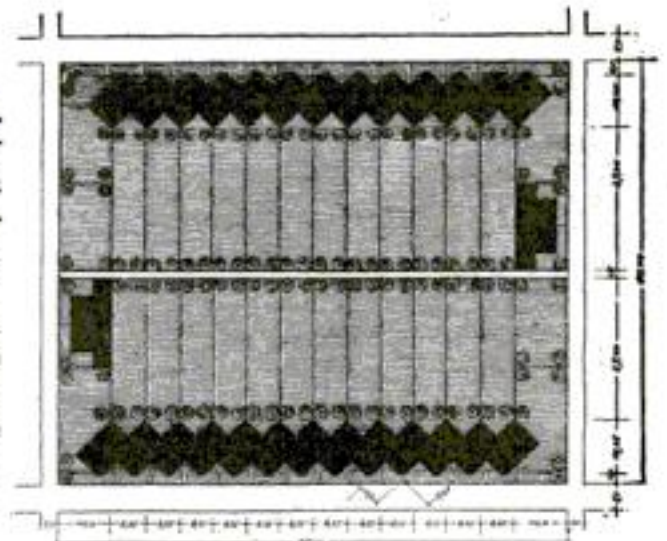
More Light and Air for Dwellings

SMALL dwellings are often built in rows for the sake of economy. They require less ground space and less building material than detached houses and can be easily supplied with heat, light, and water from a supply center. The great disadvantage of this system of construction lies in the curtailing of light and air, which have access from front and rear only.

How a firm of builders solved the problem of providing more light and air to small dwellings in rows, without materially increasing the cost of construction, is shown in the accompanying illustrations.

Each house has its little front garden, secure against the prying curiosity of neighbors and

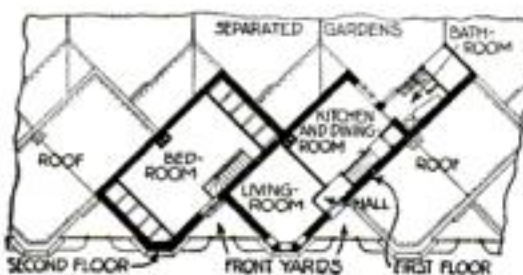
an equally protected garden in the rear. The front garden has an area of only four square yards, but the garden in the rear, which extends to the alleyway through the middle of the block, contains two hundred square yards. Stable and outhouse are built as an extension of the dwelling and give access to the rear garden. The ground floor of the dwelling comprises one living-room with an area of about sixteen square yards, the kitchen, a trifle



By "staggering" the houses, each one receives a greater exposure to the open air

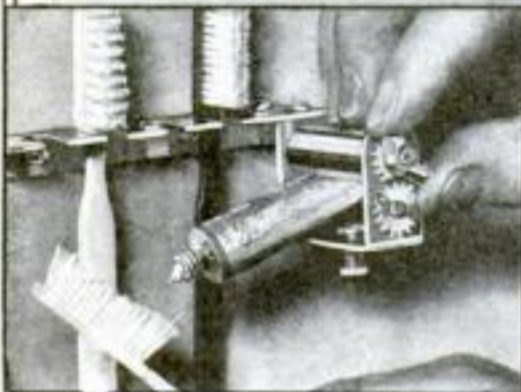
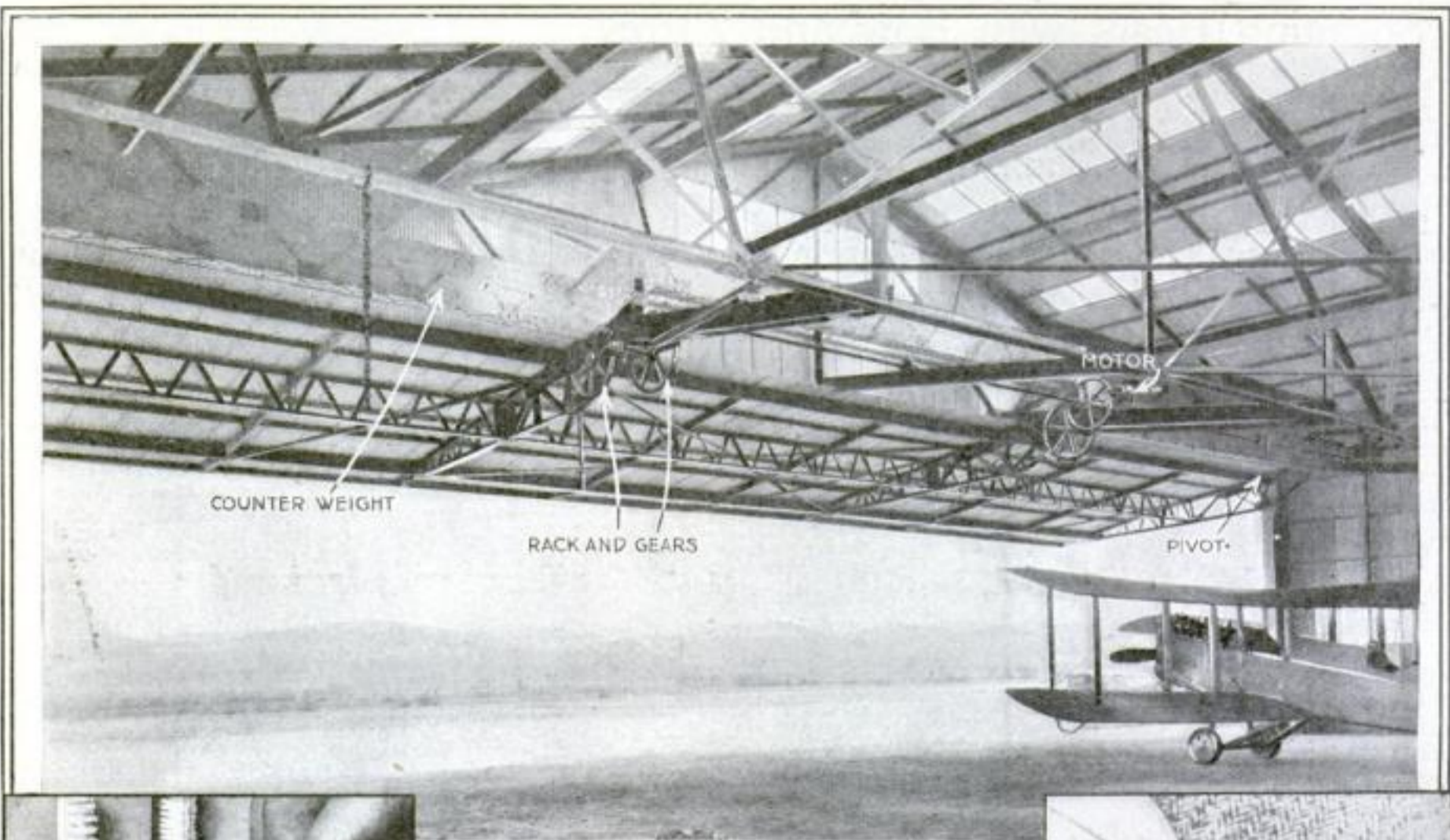


A front yard, back yard, and plenty of fresh air are unusual for city houses, but this arrangement provides all three. The floor-plans are shown at the left



smaller than the living-room, and an anteroom, about two yards square, to which the front door, located in the angle of the front yard, gives access from outside. Bedrooms were in the attic.

Light and air may be admitted from four directions, which insures adequate lighting and ventilation, with their concomitant health and happiness.



Saves Time and Tooth-Paste

YOU can now extract the last bit of toothpaste from the tube, which means economy; but this little novelty's great advantage is its convenience.

The tooth-paste tube is held in the wringer by the set-screw at the bottom, and the exact amount of paste required is forced out by a turn of the butterfly screw, as illustrated.

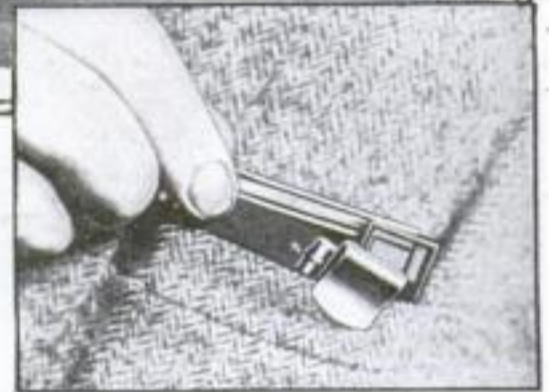
No more delay while you fumble for the tube or hunt for a mislaid cap.

This One-Hundred-Foot Door Will Open in Twenty Seconds

A DOOR one hundred feet long and twenty-one feet high, which can be opened in twenty seconds, is the feature of the hangar built for the Postal Aerial Service at Reno, Nevada. The door is the invention of J. B. Strauss. Its speed in action is the result of adopting the construction principles of the bascule bridge.

The door is hung on tinnions at the top of the door-jamb and swings outward. It is balanced by a concrete counterweight of 37,500 pounds, so that it is always in exact equilibrium on its axis, and very little power is required to move it. A five-horsepower motor is used, which operates a train of gears that act on two operating pinions engaging two cast-iron racks bolted to the door-girders.

This design is of great value to the air service, since it eliminates wind eddies near the door.



Memorandum-Book Clamp

GREATEST of drawbacks to the convenient vest-pocket memorandum-book is its tendency to fall out of your pocket. The notes in a memo-book are always important, and the inexpensive little novelty pictured will insure you against their loss.

It is in the form of a double clamp. One half fastens to the book, the other to the pocket, and you remove and replace the book as you do a pen.

New Forward-Driven Helicopter Propeller

TWO propellers are provided, rotating in opposite directions at the same speed to exert a constant pull and thrust. The blades are shifted about their individual axes, suitable gears being provided for controlling the operation of the blades relative to the shaft rotation.

By substituting a drive-wheel for the motor, the mechanism can be used as a wind wheel and the power transmitted to machinery.

When the invention is attached to a helicopter, the gears are arranged so that shifting a lever changes part of the upward thrust into a forward movement.



The forward-driven propeller



He's getting a mechanical polish

Shine Delivered in a Minute and a Half

SHOES are now shined by machinery in the manner shown here. After you are seated, you drop a coin in a slot at one side and pull a lever. A set of brushes starts traveling around your shoes and they remove all dust. Then another set of brushes with a supply of liquid polish follows right in the path of the dusting brushes.

Next come the polishing brushes, and then a flannel belt that adds the finishing touches.

The entire job is completed in a minute and a half. The cost of operation is but five cents an hour.



Dipping Hands in Water Stops Headaches

ONE unusual method of curing headaches, according to a report from England, consists in immersing the hands in electrified water. The apparatus, which has been unusually successful, is simple to put into operation.

The picture above shows a basin of electrified water and the apparatus that delivers the current. This apparatus is self-sufficient, containing three dry cells. The electricity passes from the terminals into the water and starts the blood circulating in the patient's hands, and the congestion disappears.

WOMEN will be glad to hear that the British Imperial Antarctic Expedition reports large colonies of seals and penguins at Enrood Bay. Unfortunately, that is so far south and so hard to reach that these animals run little immediate risk of becoming fashionable fur coats.

Scooping Sea-Water for Salt

WHEN the wind blows, the sails of the strange windmill below go round and as a result salt water from the canal is dumped into fields to evaporate. Such is the primitive method of obtaining salt in the Tangku district near Peking, China.

An endless chain with buckets attached is connected with the windmill so that it is set in motion whenever the wind blows. The buckets scoop up the salty sea-water and empty their loads in the salt-field behind.

In a week's time the water evaporates, leaving a salty crust on the earth. This is collected and sent to all parts of China; the salt is used in its natural state.

Gardener Finds Second Mastodon

AN Italian gardener of Newburgh, New York, Anthony Fischera, has unearthed two mastodons from his garden. The fossils were found only three feet below the surface, lying on their side, so that the feet were the first bones uncovered.

The skeletons are almost complete, but the bones had not turned entirely to stone, and are so porous and soft that great care will be necessary to carry the find to a museum.



He's Sitting in the Ocean on a Balsa-Wood Chair

SITTING in the water in a chair made of balsa wood is the latest seaside sport. This particular kind of wood is very light and, in consequence, is sufficiently buoyant to hold a man indefinitely on the surface of the water.

The chair has a low back and a long seat; there is a wide arm at either side. When the water is smooth you can easily read a paper while sitting in the chair. The picture above shows a man doing this.

WITH the help of airplanes and moving-pictures the Nebraska Department of Conservation and Soil Survey is making a pictorial map of the state. Notes on these photographs will give the soil-conditions and geology, while the photographs will show the geography and essential industries.



Musical Shorthand Is Recorded for the Composer

IMAGINE that a composer is extemporizing on the piano. He strikes an effective melody—but before he can get the notes on paper, he has forgotten them!

The piano-keys are connected with the extempograph by a series of slender aluminum rods, which are counterbalanced in such a way that they do not affect the touch of the piano in the least. Each rod actuates an inked wheel that marks a revolving sheet of paper as long as the note is struck, and these marks form a permanent shorthand record and preserve the composer's inspiration.

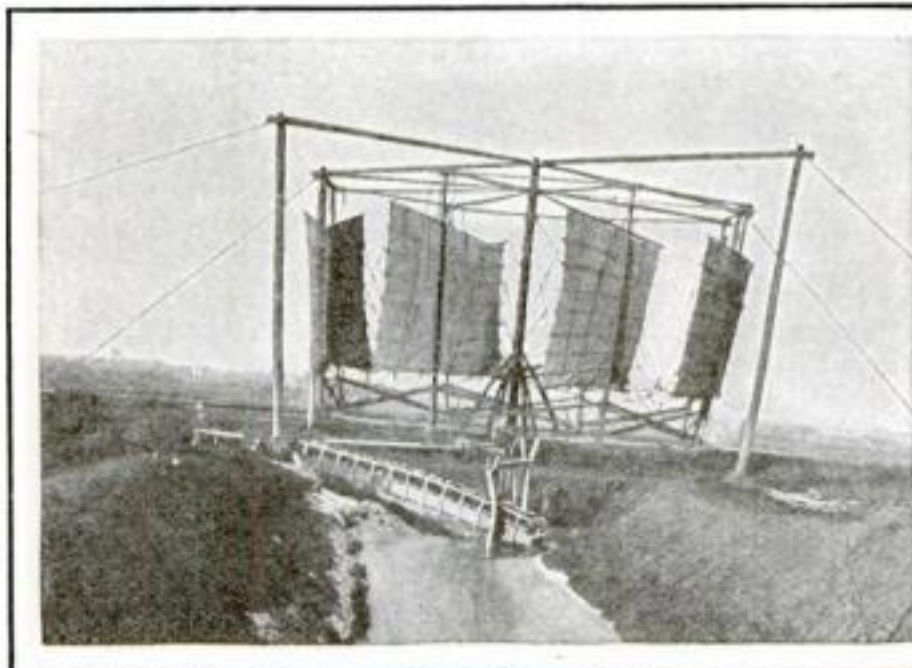
An Ambulance for Automobiles

THE garage men of San Francisco maintain a service for wrecked or disabled automobiles as complete as the first-aid ambulances for the injured pedestrian operated by the hospitals.

Completely equipped wrecking-cars are ready day and night to dash to the scene of the accident and either repair the broken car on the spot, or, in case it is badly injured, carry it back to the garage for extensive treatment.

The trailer for carrying a badly smashed car is shown in the picture. The large chests on each side contain all the tools and spare parts needed in an ordinary repair job, including searchlights for night work.

© Keystone View Company



The Chinese get their salt by windmill power



Outfitted with tools and trailer, this wrecking-car makes prompt repairs



Cycling Sixty Miles an Hour

YES, this ten-man tandem bicycle can beat the average touring-car over good roads. With ten husky enthusiasts pushing the pedals the machine can make sixty miles an hour and unless it is traveling at least fifteen, it is hard for the man in front to keep it upright.

This elongated bicycle is owned by Walter Metz, of Waltham, Massachusetts. It is a little unwieldy on corners, but is speedy enough on the straightaway and affords its ten riders an enjoyable afternoon's sport making motorists take their dust. The machine's wheels are as heavy as those of a small automobile.

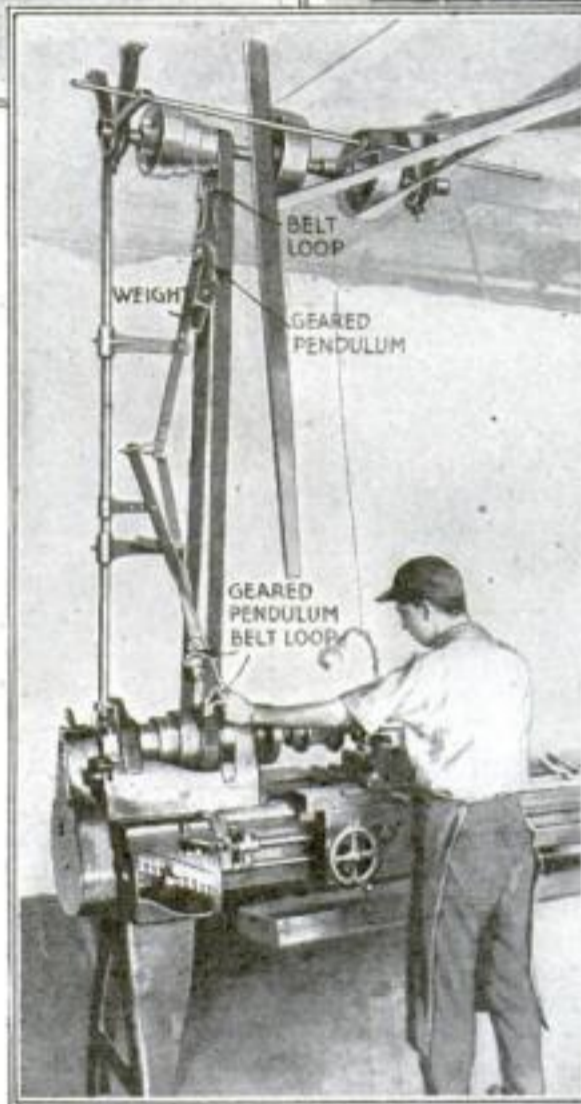


An Electric Shock through Glass

AS an advertising novelty upon opening a new drugstore, passers-by were invited to step up and get an electric shock through a plate-glass window. Impossible? Not at all.

A conducting plate was placed against the inside of the glass and charged by an induction coil. When a hand was placed against the window, a condenser was formed, since two conducting surfaces, the hand and the metal plate, were separated by the pane of glass.

The shock was not severe, but it helped the recipient to remember that particular store for some time to come.



This Mechanical Belt-Shifter Prevents Accidents

CHANGES in speed on machinery driven from line-shafts is brought about by shifting the belt from one pulley to another. Careless operators do it with their hands, and many serious accidents occur. When a hand is caught between a fast-moving belt and a steel pulley, there is little hope for the hand.

The mechanical belt-shifter in the picture above will lift a heavy belt from one pulley to another by the manipulation of the lever. The belt passes through two steel guides, one at the top and one at the bottom. Motion applied to these guides through the lever will force the belt off one pulley and lift it upon another pulley.

You turn the switch—but the light does not go out until you are comfortably in bed. A new electric light contains a thermostatic element that thus delays the quick-break switch action.

This Is Not a Toy Bicycle

THE German inventor claims this bicycle is not a toy, but a cheap, inexpensive, practical machine on which a man can pedal twelve miles an hour.

The wire wheels have solid rubber tires, the frame is of lacquered wood, and the drive is a reversion to the old cable type of the early bicycle.

There are two speeds, so that the rider may climb hills easily and use the high gear on level ground; also a coaster brake is provided.



New bicycle revives old-fashioned cable drive

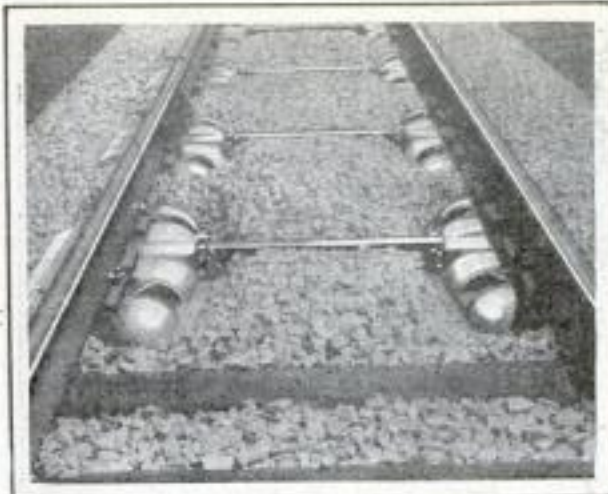
Inflated Tube for the Sea

IF you can't swim, wear an inflated rubber tube around your body; it will hold you on top of the water in spite of yourself.

The picture below shows a swimming-tube that has been put on the market recently. It comes in various sizes. The air-valve is waterproof and is covered with a wide band of rubber that protects the wearer from contact with the valve. The tube is not unlike the inner tube of a small automobile.



She feels happy and safe with her life-saving tube



Railroad-Tie with Enlarged Surface

THIS new railroad-tie consists of a metal frame filled with concrete. The tie is composed of two inverted elliptical spider-shaped bars running lengthwise with the rail and connected crosswise at their center by means of a T-bar. Each bar is a cast metal spider, cup shape, with sides tapering upward and inward from the base. This cup-shape casting is open at the base and is filled in with concrete properly reinforced with T-bars running crosswise from side to side within the cup. The rail is attached to the tie by means of bolts.

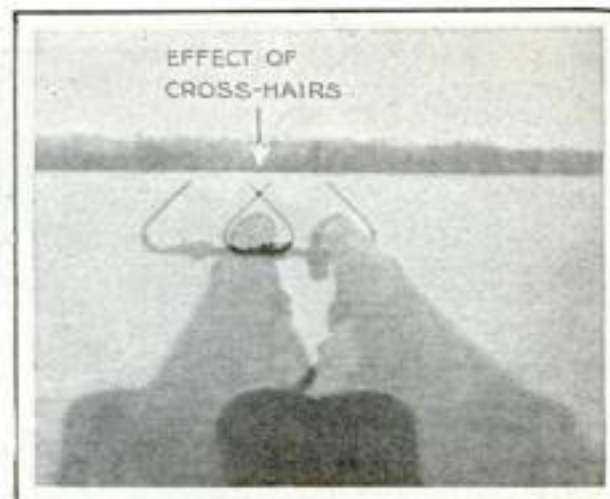
As the bearing is placed lengthwise, a greater proportion of the rail actually rests on the ties, so that fewer ties may be used, and tie-plates, rail-braces, and spikes eliminated. It is argued that 960 pairs of these ties to the mile would replace 3300 wooden ties.

In view of the large base of the bearing section, it is thought there will be less expense of tie-clamping and general roadbed upkeep. Anti-creepers are unnecessary; there is more resistance and the lateral movement of the track in the roadbed is done away with. There is also a possible saving in the elimination of fire risk and in the scrap value of old ties.

Crabs Walk Off with Clocks

CHRISTMAS ISLAND, in Oceania, is infested with landcrabs two feet across which swarm over the camps of travelers in such large numbers as to be dangerous. A party of astronomers, led by Admiral Wharton, were unable to protect their supplies, and the crabs even carried away two large chronometers.

© Keystone View Company



Better Aim with Both Eyes Open

IT is physically impossible to see clearly the front and rear sight of a rifle and the object aimed at all at the same instant. The eye will focus only on one object at a time, consequently in aiming we glance rapidly at one object after another, and pull the trigger when the rear sight, or the front sight, or both, is slightly blurred.

Sighting with one eye is scientifically incorrect, yet no basic improvement was made in sights since the days of the crossbow until the introduction of the strange-looking affair above.

This gun-sight employs a new optical principle. Hold up your finger at arm's length, and look, not at your finger, but at an object some distance beyond it. You will see your finger double, of course, for you see a finger with each eye. That is the principle of the open-eye gun-sight.

No front sight is used. Both eyes are kept on the target, and the slanting vanes of the sight seem to make a cross. When the cross rests on the bull's-eye, pull the trigger, and you will score a hit. No sight-setting for range is necessary since the broad sight forms a short baseline of a triangle.



Scotch Fishermen Trawl for Coal

MANY of the fishermen of Leith, Scotland, have given up fishing and are now trawling for coal.

Leith is situated on the south shore of the Firth of Forth, and steamers are constantly going in and out. When they coal up, a considerable amount of coal is dropped into the water. It settles at the bottom of the bay and the fishermen have found that it is easily recovered by the use of regular trawling-nets.

You Can Cut Your Own Smokes

SUCH a machine as this is useful when it is hard to buy tobacco ready rubbed. This is the case in Germany, where tobacco is fast becoming a luxury only to be indulged in by war profiteers.

The machine is self-feeding, and the knives may be removed and sharpened on a grindstone. The width of the cut can be adjusted to the operator's desire—fine for cigarette tobacco and coarser for pipe mixtures.

Cutting by hand, the output amounts to about twenty-five pounds an hour.



Cutting tobacco by hand

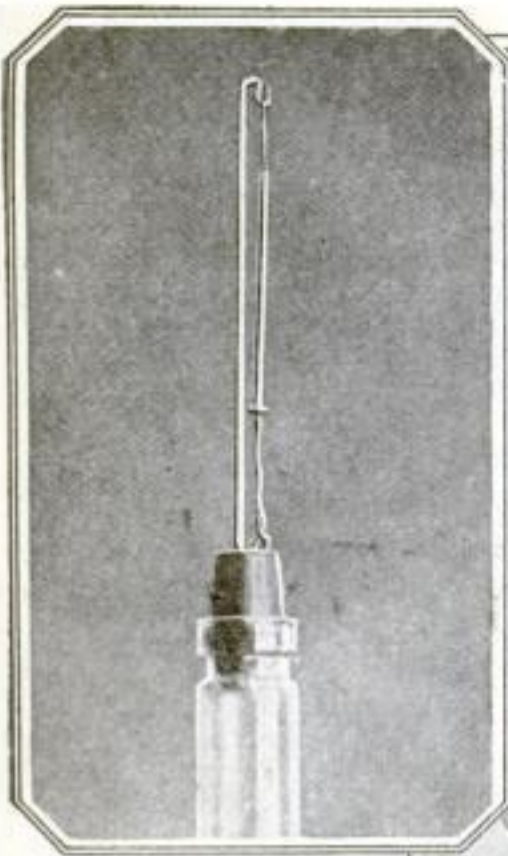


Almost human is this tying machine

Tying Packages by Machinery

WITH this invention even comparatively large packages can be tied. The package is placed upon the table. A handle is rotated. This causes the binder arm to be swung to a position below the bundle and under the table to carry the cord into the knot-tie.

While this takes place, the cord controlling arm is moved forward with the binder arm, the tension device supplying the requisite tension. After the knot is tied, the binder arm returns to position. This machine is operated by hand or electricity.



Lengthwise Hole Bored through Pin

DO you pride yourself on your skill with tools? Then try this. Take a common pin, bore a hole through it lengthwise so that the drill emerges exactly at the pin-point, and then pass a wire through the hole.

William Human, watchmaker of Cambridge, Massachusetts, has accomplished this feat, and the pin hangs in his shop-window. In addition to possessing this wizardlike dexterity, the watchmaker has several electrical inventions to his credit.

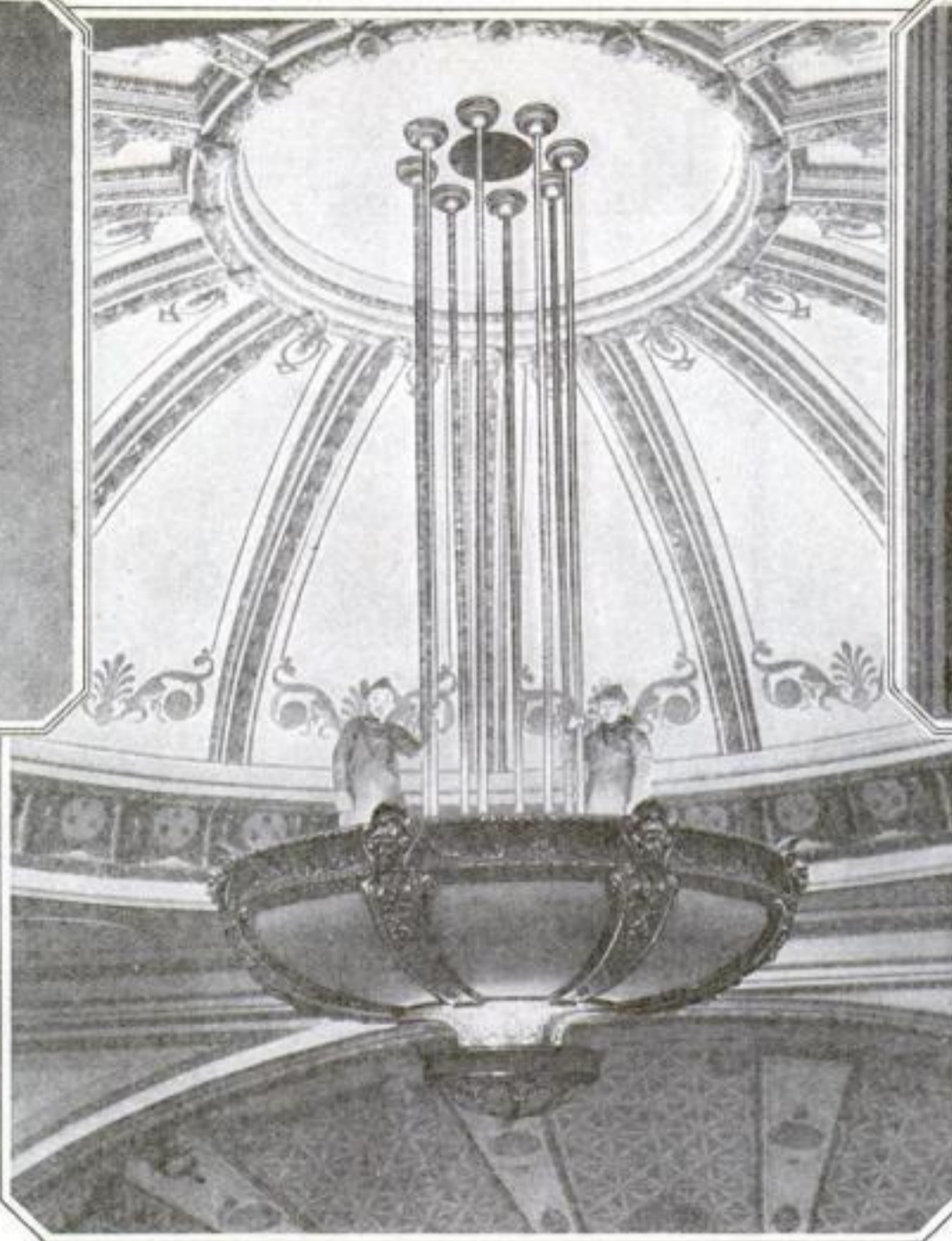
Try This Motorcycle Mudguard

THE motorcycle grows more elaborate every day. Note the one in the picture. Not only has it the latest thing in lamps and a streamlined enclosed sidecar, but it has mudguards and an apron that afford almost as much protection to the driver as a car could offer.

The mudguard fastens far enough under the machine to protect the engine and comes as far as the driver's knees, then the apron does the rest.



Rain and mud do not bother this cyclist

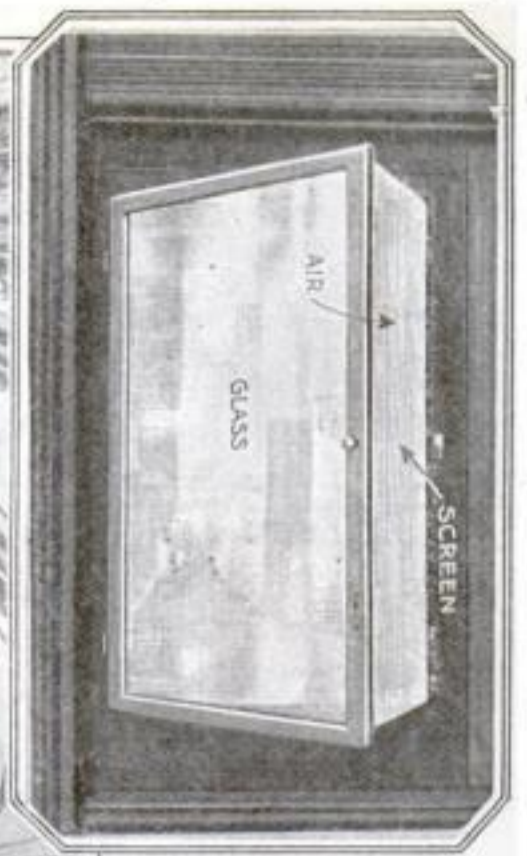


Indirect-Lighting Fixture Weighs Two and Three Quarter Tons

FOR the advantages of indirect lighting, the Alhambra Theater, of Milwaukee, installed a fixture fifteen feet in diameter and weighing fifty-five hundred pounds. This is the largest fixture ever constructed, and its size and weight necessitated novel arrangements for support and for cleaning.

The main bowl contains one hundred 200-watt lamps with special reflectors. Since colored lighting is the feature of the installation, these lamps are divided into four groups of red, blue, amber, and white. The colors are obtained by cover-glasses placed over the reflectors. The lower bowl contains eighteen 60-watt lamps. It is used to illuminate the bottom of the main bowl, and for emergency use in case of accident to the main installation. Sixteen similar small fixtures are employed for auxiliary lighting in parts of the theater that cannot be illuminated by reflection from the main dome.

The large fixture of the theater is suspended by eight 2-inch pipes instead of by chains, which hangs in the center of the dome over the auditorium. It is too high above the floor to be reached by ladders, and to permit frequent cleaning, a hole is cut in the ceiling through which a ladder may be lowered into the interior of the large bowl. To clean the outside of the bowl, a cable is lowered from the smaller fixture beneath, and a man cleans it with a specially designed broom.



Ventilator Admits Light and Air

WISHING to ventilate a room without direct drafts and still to be able to see out of the window, two Maine boys invented this device.

On the inside of an ordinary adjustable window-screen, a glass shutter is fitted, opening from two to eight inches on hinges at the bottom, the aperture at the top being controlled by a cord and a thumb screw.

The screen keeps out flies, and by the use of glass, air is admitted without excluding light or preventing the occupant of the room from seeing out of the window.

It Lifts the Iron between Strokes

IRONING clothes is tiresome work. What makes it so? The constant lifting of the heavy iron. In the course of ironing one shirt the iron is lifted at least thirty times. Now, however, there is a spring attachment that will do the lifting. As the handle is released, the iron springs up from the board.

In the picture below a woman is adjusting one of these lifting devices before she starts ironing.



See what your wife thinks of this iron-lifter

How a Mechanical Tamper Reduces Labor Costs



This Bolt Can Be Extended to Any Length

BY adding extension pieces to the short three-inch bolt it can be extended to any length desired.

The device is especially adapted to temporary brace-roads, since by taking up on the nuts between the connecting pieces the brace-rod can be tightened like a turn-buckle.

The connecting nuts between the extension sections are made unusually long to give stiffness and strength to the bolt.

VIRTUALLY every day new patents and improvements are made in the methods of laying concrete roads. The machine shown below trims off surplus concrete, tamps the road twice, and finally surfaces with a canvas belt.

All these operations used to be performed by hand and a large crew of laborers was needed to keep the concrete mixer operating at full capacity. This mechanical tamper is always waiting for more concrete to be mixed. It is driven by a gasoline motor, and will handle any width of roadway up to thirty feet.

The entire operation is in charge of one man, who works either from the side, or seated in the center. The device is made so that it can be readily disassembled and loaded on a truck when moving from one job to another.



Soft Focus Effects Obtained without Retouching

SUCCESSFUL portrait photography depends to a great extent upon skilful retouching and modeling of the negative. As a consequence, the work of expert operators, dark-room men, and printers is lost for the lack of the necessary skill and care in the retouching department.

A special retouching screen recently patented enables the photographer to give his portraits the stipple effect and the natural modeling heretofore associated with the work of the most expert retouchers. The negative is given the usual proof retouching, and then printed with a special screen placed between the plates and the paper. The result is a perfect blending of high light and shadows.

NEARLY 80 per cent of the nation's electric light and power is consumed east of the Rockies, with New York and Pennsylvania leading as current users. However, the consumption of electricity per capita is greater in the West, since the Mountain and Pacific states use 20.8 of the electric power, but have only 8.3 the population.



With this machine one man can level, tamp, and surface a new concrete road

Passengers Hoisted Ashore at Nome

ANY one going by boat to Nome, Alaska, will find that instead of walking up a gangplank he will be hoisted ashore on a small platform by means of a block and tackle. No docks have been built and the steamers must anchor out in the harbor while comparatively small boats are used to bring passengers to the shore.

This device is a refinement of the deck derrick, long in use for loading and unloading live stock on and off ships, but as human freight demands more dignified treatment, it is afforded the luxury of a platform.

It is almost impossible to improve the harbor at Nome because of the winter ice-floes that are sometimes thirty feet high on the beach.

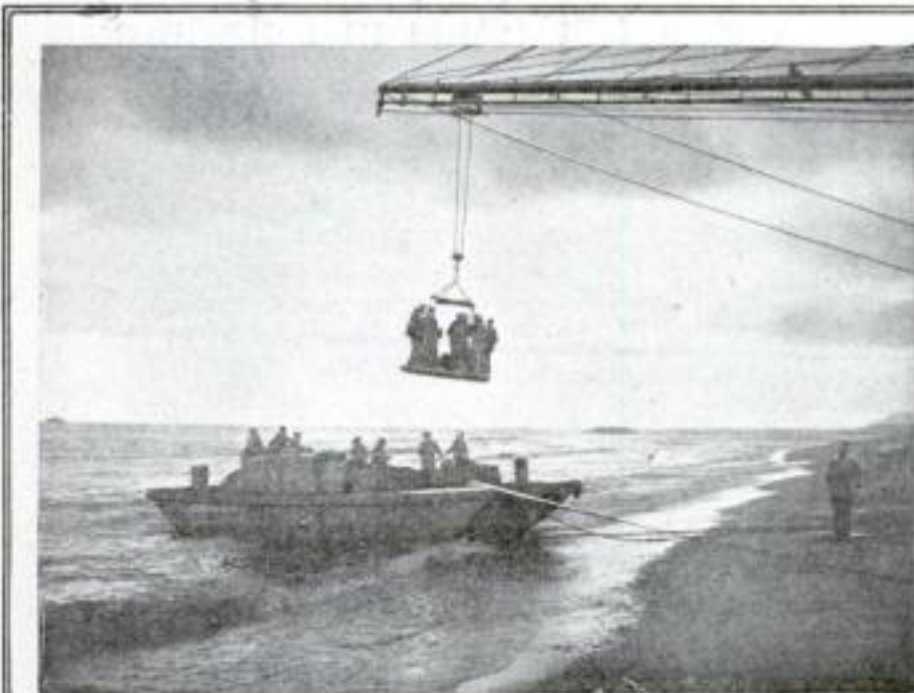
© Keystone View Company—Burton Holmes

Testing Incandescents for the Railroad

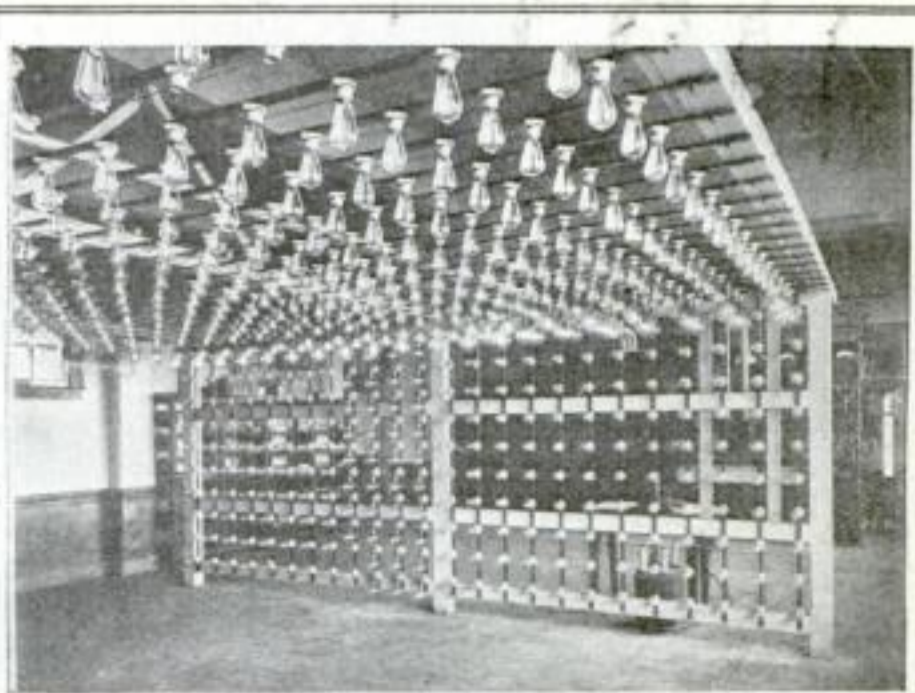
THE Pennsylvania Railroad has adopted this "grape arbor" arrangement for testing electric-light bulbs in order that its electricians may maintain a continuous lighting service on the trains. The "arbor" can test one thousand lamps at a time.

The tests determine the probable life of the lamps under the conditions of railroad travel. Continuous vibration, and the jolting and jarring of the trains, cause some lamps to burn out more quickly than others, and before installing a new lot these tests inform the electricians how long the lamps may be left in the cars without need of replacement.

Unusually severe testing is given lamps used in switchlights, where absolute reliability is the first requisite, since an extinguished light might cause an accident.



Passengers for Nome have a dizzy experience before them



Testing electric lights to be installed in railroad cars

Tractors Tear down Houses and Tear up Pavements

TRACTORS that helped tear up the enemy's trenches during the war are now being used for tearing up pavements and tearing down houses. Their great strength and gripping power make it possible for them to be employed in this fashion.

In Madison, Wisconsin, a baby tank bored right through the brick wall of a three-story building. The bricks fell on top of the tank, but its thick steel plates protected the men within from injury.

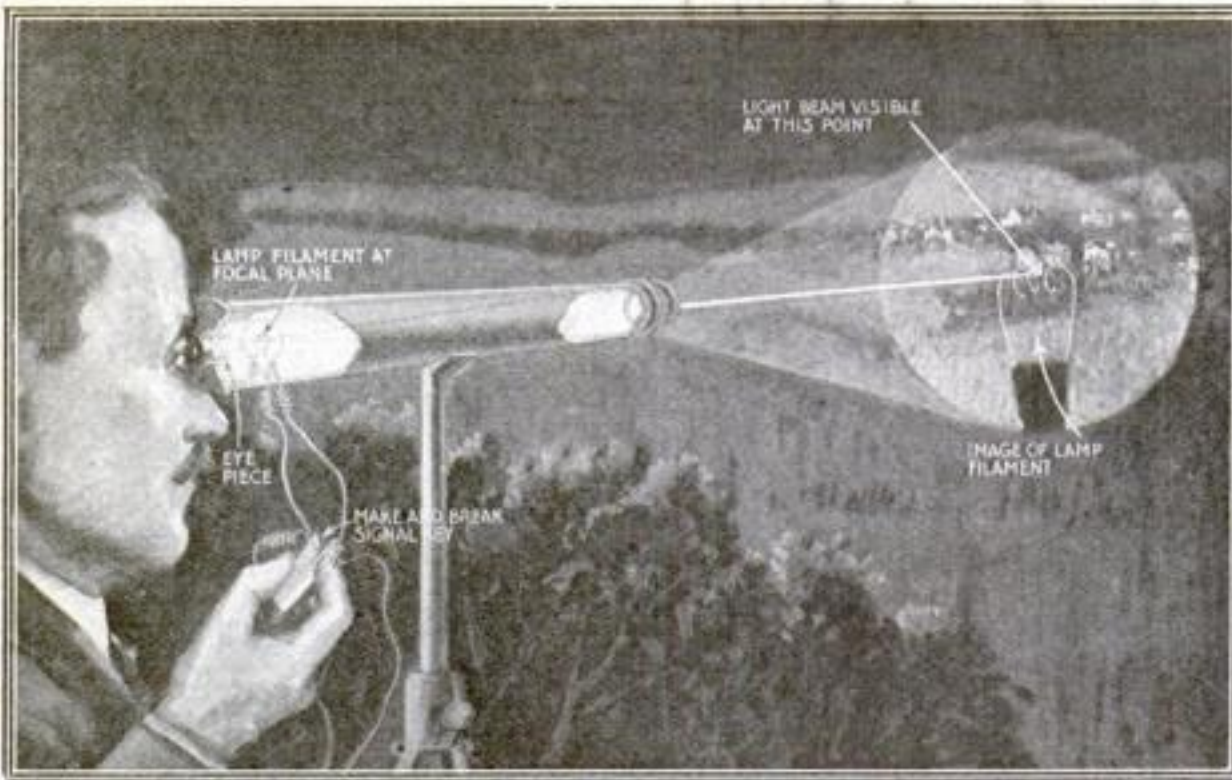
It was in Sacramento, California, that a tank was used in ripping up pavement. A plow was attached to the tank, and the tank supplied the motive power.



This whippet ripped up a Los Angeles pavement as easily as a trench



In Wisconsin they use the tank to batter down houses instead of "pillboxes"



The telescopic flashlight sends a signal beam straight across country to a receiving station with the enemy none the wiser. It has a high military value

Flashing Messages with a Pencil of Light

SECRECY in the transmission of military messages is of the utmost importance. Radio signals may be made secret to a certain extent, but the transmission of light signals is another matter.

An ordinary source of light can be seen from a great distance, since it spreads out from the source point and becomes visible over a wide area. Light from a source point traveling in a perfectly straight line will be visible over only a very small area.

The invention shown above is designed for transmitting military messages by light flashes invisible to the enemy, the secrecy of the messages

depending upon the very small area covered by the light beam at the distance or receiving station.

A further object is to provide an instrument that may be operated with the assurance that the light rays will be accurately projected only on, and visible only from within, an already predetermined area.

The device is a combination of telescope and flash lamp, the latter being so located within the former as to illuminate only a selected area, thereby rendering the signals visible only within the area illuminated.

New Devices to Aid War Cripples

FOR the benefit of the many unfortunate men who lost both arms in the war, John H. Martin, of London, has invented a clothes clasp that takes the place of button and buttonhole. Artificial hands can manipulate clasps but not buttons. The picture shows how Mr. Martin, himself handless, has attached the coat clasps to his coat and vest, operating them in the same manner as the snap fasteners that are used on women's clothes.

For persons who have lost but one arm, William Finckhouser, of Vanwert, Ohio, has invented a convenient washing device. It consists of a rubber suction cup on which is secured the back of a brush. The suction cup can be secured to the bottom of a basin because the walls of the cup expand, creating a strong enough suction.



Snap fasteners replace buttons for those who have lost one or two hands



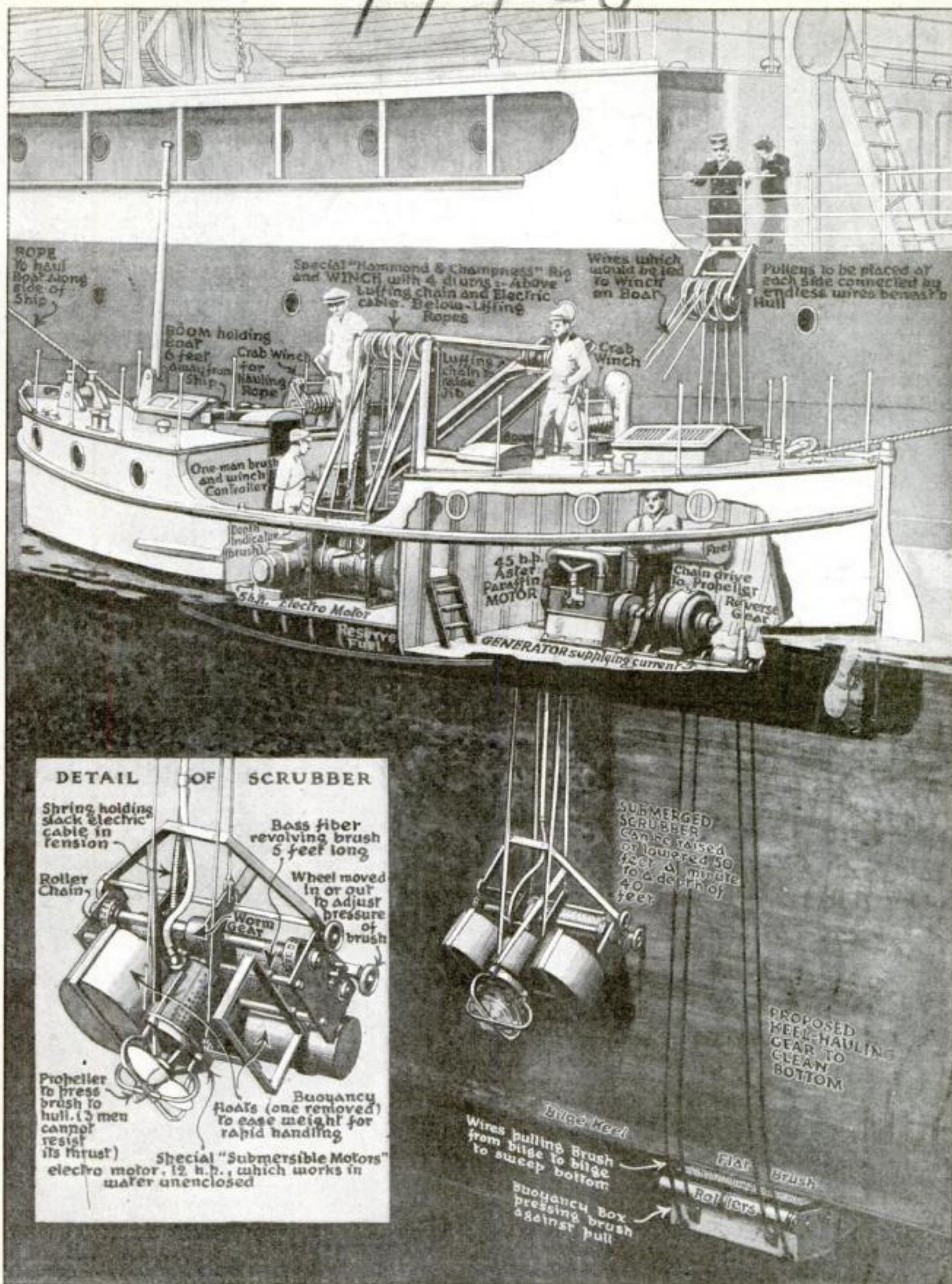
This brush is firmly held to the bottom of the washbowl by a rubber suction cup

The Cause of Sunken Joints in Furniture

FURNITURE tops are generally built up of five plies of wood, consisting of a core, cross banding, and faces. The core is usually made of several thin sections glued together. A sunken joint always occurs over joints in the core stock, and appears as a long, shallow depression in the surface of the furniture.

The U. S. Forest Service finds that sunken joints are caused by too rapid preparation of the core. The wood next the joint absorbs moisture from the glue and swells. If insufficient time is allowed between gluing and surfacing, more wood will be removed near the joints, because of the swelling at that point. After complete seasoning, the shrinkage makes a depression.

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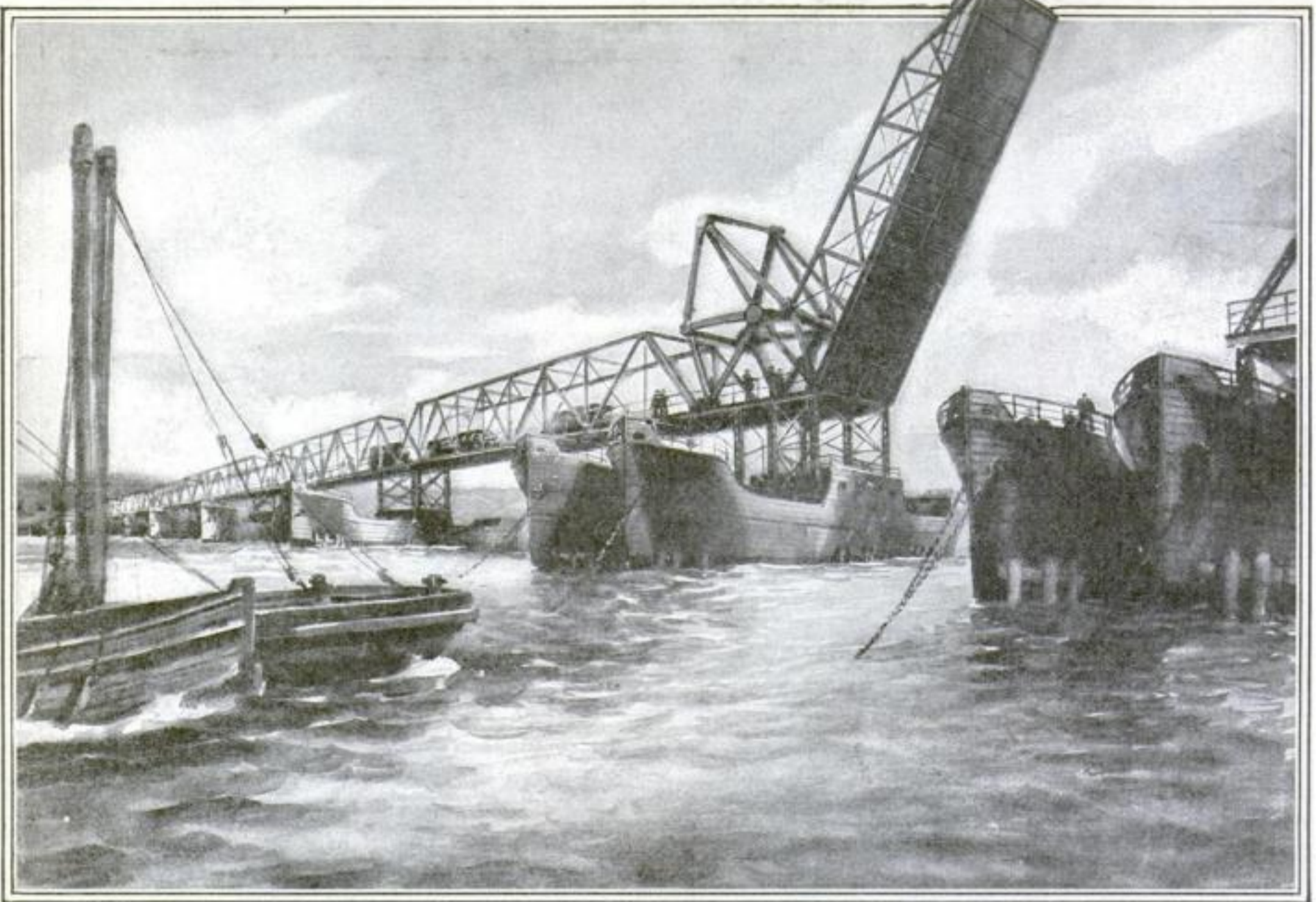
Drawing by S. W. Clatworthy

Electric Scrubber Cleans Ship without Drydock

EIGHT hours to clean off any accumulation of barnacles, "grass," or shell from the entire hull of an eight-thousand-tonner, and the whole job done while the ship is lying at the dock unloading or taking on a new cargo!

This picture-diagram shows how, by means of the new rapid

submersible ship-cleaner, the work of "cleaning her up" has been revolutionized. With this apparatus, installed in a special boat, the underwater accumulation of marine growth that can cause a five-thousand-ton, ten-knot boat to lose seventy-two sea miles daily, equivalent to five tons of coal a day, is removed



Remember the wartime phrase—"A Bridge of Ships to France"? Now it looks as though boats built under that slogan would actually be made into a bridge—the strangest one in the world

Pontoon Bridge of Wooden Ships May Span the Hudson River

FAMOUS engineers are discussing a project to bridge the Hudson River with a temporary structure supported by pontoons constructed from wooden ships built for the United States Shipping Board during the war. This bridge would extend from Yonkers to the Palisades while a permanent suspension bridge is being con-

structed. Gustav Lindenthal, designer of the famous Hell Gate Bridge, declares the pontoon project presents no difficulty from an engineering standpoint; that it could be placed in ninety days, and would carry traffic for ten years.

The bridge will be 3,020 feet long, supported on fifty ships, each 265 feet

long by 45 feet beam, placed 100 feet between centers, and moored with screw-piles. To permit navigation, one or two bascule bridges would be introduced. The flooring will be 40 feet above the water, and a double 10-foot roadway will carry the traffic, estimated at 100,000,000 vehicles and 200,000,000 passengers annually.

An Airplane Flight in Comfort at Eight Cents a Mile

DECISIVE progress in commercial airplane design is shown in this new British airplane that transports eight passengers at a gross cost of eight cents a mile, including fuel, pilot, insurance, maintenance, and every person connected with the operation of an airplane line. The plane has been expressly designed for the comfort and safety of passengers in commercial flying.

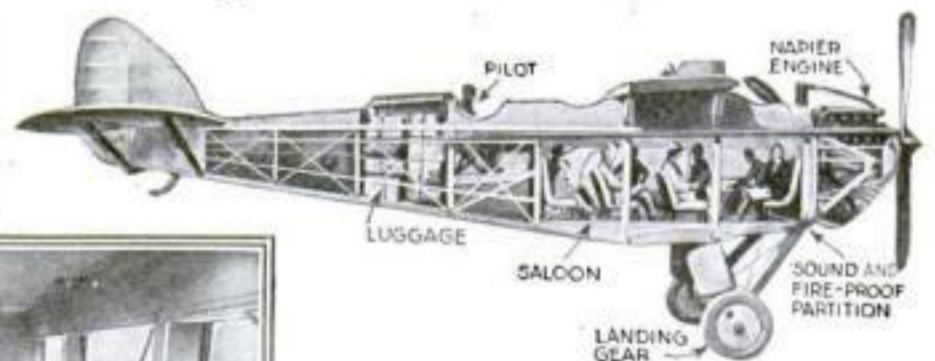
The cabin resembles that of a motor-boat cruiser, and is fitted with comfortable seats. In a cockpit in the rear each passenger can put thirty pounds of baggage without charge. If the plane is used solely to carry freight or mails, its capacity is 2,200 pounds.

The plane embodies two novel refinements advantageous to the commercial airplane. The first is an improved landing chassis that absorbs the shock of landing.

The second feature is the large



Every comfort and convenience in airplane travel is supplied in this cabin at the low cost of eight cents a mile



A cross section of the economical passenger-carrying plane in use between several of the European capitals

angle of incidence when the tail is on the ground, which is said to cause the plane to pull up quickly after landing. A sound- and fire-proof partition between the engine and the passengers' cabin reduces the noise during flight.

Spills that Thrill

Accidents the racing driver faces at every meet if there is any failure in judgment or mechanism



Eddie Pullen took this corner of the Santa Monica track at too great a speed. The right front wheel was torn completely off the axle and the car jumped off the track and flew through the air into the barrier. The two spectators seen running from the point the car will strike were able to escape in time. The collision is shown in the lower left-hand picture

18344

Old Man Centrifugal Force decided Johnny Marquis was in too big a hurry, so over went the car. Johnny's rabbit's foot made the car skid on its side and the driver and mechanic slid into the dirt. All they needed was a wash



Eddie Pullen striking the barrier after losing his front wheel. The machine was smashed to pieces, but the men were thrown over the fence without suffering any serious injury



Wheels, tires, and axles stood the strain of this skid, but luck was against the driver, Walter Melchor, at Santa Monica, and he was killed when the car turned turtle



A motorcycle on a hill is worse than a bucking bronco, and when the throttle is pulled open, something is bound to happen. This time the rider was thrown off and landed on his feet. He resumed the race



Stein was standing too far out on the curve and is about to crash into the trees at the left. Both men bounced from a fence on to the lawn with only slight injuries

The Biggest Feat Since the Panama Canal

That's how engineers speak of the Superpower Plan to save the East \$300,000,000 and 30,000,000 tons of coal a year

THE Superpower Plan is the greatest engineering work to be undertaken by the American people since the building of the Panama Canal. It will save the manufacturing regions of the East more than \$300,000,000 annually, conserve 30,000,000 tons of coal a year, and provide the power for 50,000 plants from a unified source.

Briefly, the scheme is to provide a single coordinated source of power for all the railroads and industrial plants between Boston and Washington, from the seacoast to a line 150 miles inland, and to distribute that power by wire to the multitude of consumption points at which it is demanded.

A series of high-power, high-economy steam-generating stations will be built where coal is cheap. These central stations will be a hundred times as large as the average power stations now being operated. Their capacity will run up to 300,000 kilowatts, and turbines will be used to get the utmost power out of every pound of coal. From these central stations the power will reach every plant in the 60,000 square miles of territory to be served over a network of high-voltage transmission lines.

This is no engineer's dream. The preliminary survey has been completed, and the estimates of the power to be developed and the savings to be made are based on carefully compiled data. Construction of the larger units will be begun before long, and new central stations now serving local districts in this area are planned with

reference to the part they will play in the Superpower Plan as a whole.

Our present system of power generation is so inefficient as to be downright wasteful. At great expense we ship energy in the form of coal, the heaviest and bulkiest form of power, for hundreds of miles to 50,000 scattered points, where it is burned in small, wasteful, isolated plants. Under present conditions the average load factor is 15 per cent. Superpower will raise this factor to 50 per cent. One horsepower will do the work of three, and we shall have to burn only one ton of coal where to-day we are burning two. This means a coal saving of 4,000,000 tons a year, and by transporting energy in its most efficient and least bulky form—electricity—the railroads will be relieved of the heavy task of carrying the nation's coal, and will have more cars available for other freight.

River Power also Will Be Used

The Superpower Plan includes supplementing the coal-burning stations by the fullest development of the hydro-electric resources of the St. Lawrence, Susquehanna, Delaware, and Potomac rivers. This contribution will amount to 15 per cent of the total energy supplied.

Perhaps the greatest savings to be effected by this plan will come from the reduction in the power equipment required and the more efficient handling of the problem of the peak load. A few years ago the coal-mines of

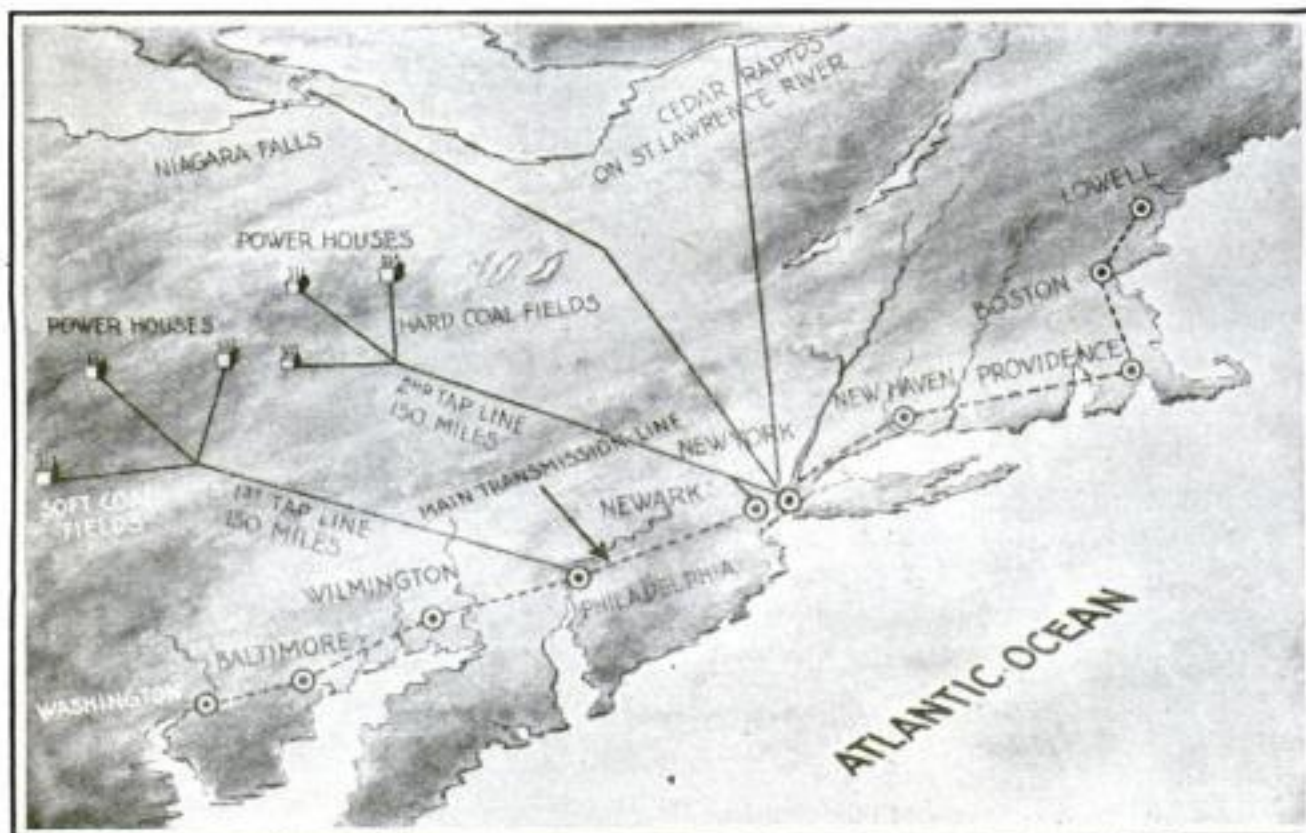
Logan County, West Virginia, drew their power from scattered plants with a boiler capacity of 4000 horsepower. This scheme of superpower was applied on a small scale, and it was found that one 500-horsepower boiler would generate enough electricity to operate all the mines!

At present we are building a plant and a quarter for every plant we require, because we must have spare capacity to guard against breakdown. Every four years our power-demand doubles, and it is almost impossible to build these little plants fast enough, while we pay twice as much for each kilowatt of capacity as would be required in the large Superpower stations, which will meet not only the needs of the present, but will anticipate the power requirements of the future.

Of the 17,000,000 horsepower consumed in the Superpower area nearly 7,000,000 are used by the railroads, and great economies will be effected by the electrification of the roads throughout the East. The determining factor, of course, is density of traffic, since electrification is not profitable on small branch lines. On the main lines the electric locomotive is more economical and more efficient than the steam-engine, particularly in the winter. In the winter, traction requirements rise, and the capacity of an electrified road rises to meet them, while in bitterly cold weather the capacity of the steam-engine goes down. General electrification will reduce the cargo space now required for industrial coal, amounting to 40 per cent of railroad freight—almost one half—and train equipment of all classes will have its service factor doubled. The saving of coal by the railroads will amount to about 13,000,000 tons a year.

The cost of installing the Superpower Plan will be approximately \$450,000,000. Changes in machinery incident to the electrification of the railroads and industrial plants, bring the total cost of the project up to \$1,240,800,000. Since the saving effected will amount to \$300,000,000 a year, this represents a return of 24 per cent annually, which makes the Superpower Plan attractive to the financier.

Its engineering merits are undeniable, and it has been approved by the highest engineering talent in the country, who agree that the plan is entirely practical.



The territory to be served by the Superpower Plan, from Lowell, Massachusetts, to Washington, D. C., showing where the electric energy will be generated and how it will be distributed



© Modern Publishing Company

Drawing by S. W. Clatworthy

How the Superpower Generator Would Dwarf Niagara

THE water pouring over Niagara Falls represents approximately 7,000,000 horsepower. The superpower development, which is to supply the entire Atlantic seaboard with light, heat, and power, will require more than 17,000,000 horsepower.

Think of a line of straining horses girdling the earth at the equator, and you will have a good idea of the meaning of 17,000,000 horsepower. This tremendous amount of

electric energy will flicker over a transmission system that will carry the current from the power stations in the coal-fields and at the base of gushing mountain streams.

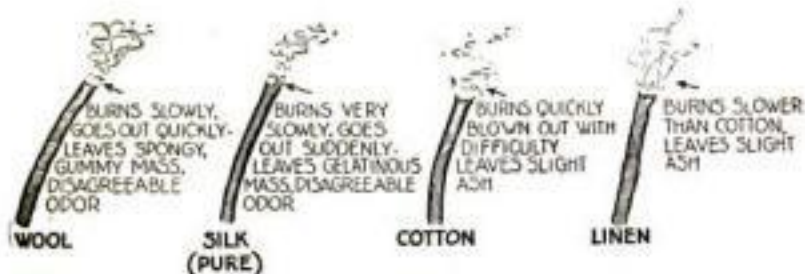
Hundreds of power stations, small and large, will be pumping their electric current into a great transmission line that will stretch from Boston to Washington. Factories, railways, and homes located within the power zone will feed from this line

Simple Chemical Tests for

The housewife can test materials scientifically in her own kitchen



TEA is frequently treated with dye to make it a more perfect green. If a sample rubbed briskly between the folds of a clean cloth leaves a stain, the tea is impure. This is a simple method of detecting such adulteration



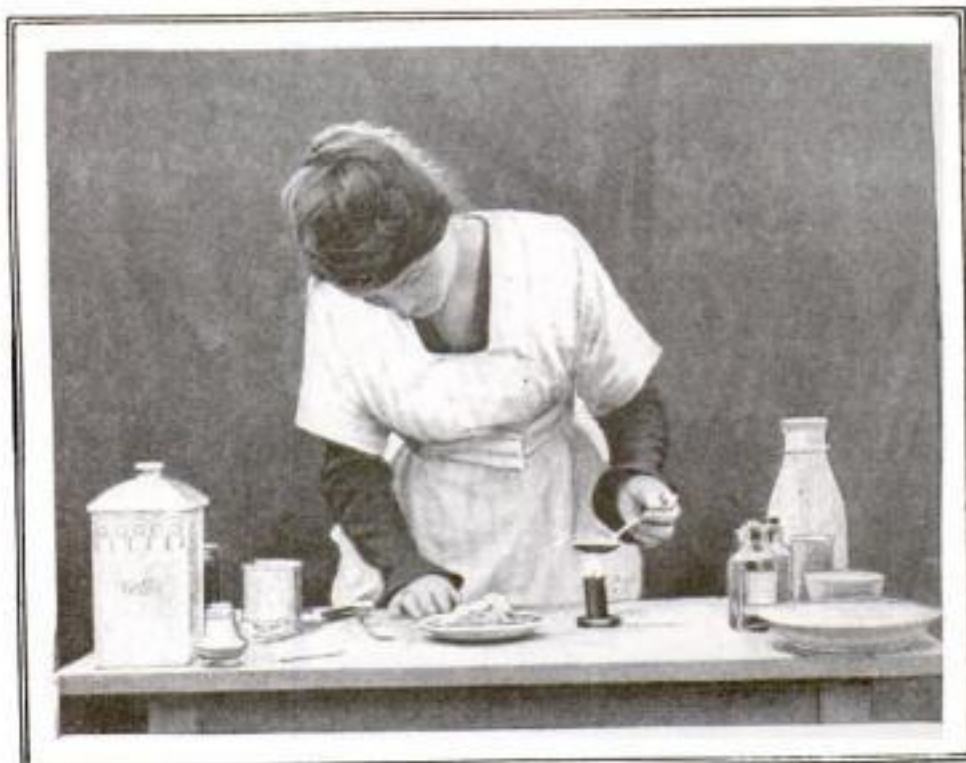
CLOTH may be tested by pulling a thread from the warp and woof and setting fire to it with a match. Wool, silk, cotton, and linen burn differently, and each leaves a characteristic ash. Why pay for all wool when what you buy is half cotton?



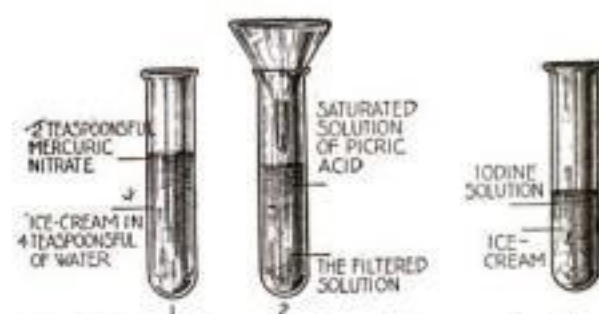
MILK that has been preserved with formaldehyde will turn violet if two teaspoonful of concentrated hydrochloric acid be added to an equal volume of milk, the solution boiled, and a drop of ferric chloride added. Two drops of paraphenylenediamine hydrochloride solution turn milk blue if it contains peroxide of hydrogen. If milk turns blue after iodine dissolved in potassium iodide solution is added, it contains starch



COLORING MATTER IN FOOD. Boil a woollen rag in the food for ten minutes, remove, add a little hydrochloric acid and a fresh rag. Boil again. A distinct color on the second piece of wool means coal-tar dye. Shaking the solution with amyl alcohol will betray the presence of vegetable dyes, which are extracted by the alcohol



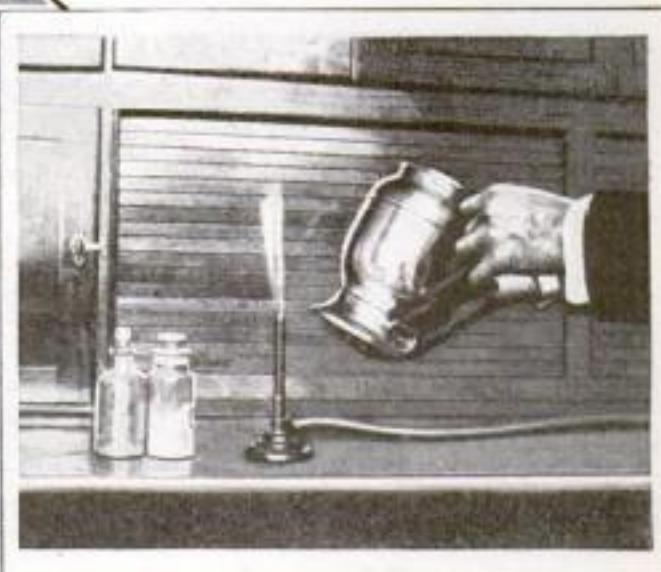
BUTTER will boil quietly over a flame if it is pure, but if any inferior ingredients or oleomargarine have been mixed, it will sputter badly. Test for coloring matter in usual way



ICE-CREAM is usually adulterated either with cornstarch or gelatine. A blue color after shaking with iodine indicates starch. If test-tube 1 be shaken, its contents filtered, and a saturated solution of picric acid of equal volume added, a yellow precipitate discloses the presence of gelatine



Professor Kugelmass demonstrating the household testing cabinet that he has invented. It contains the complete apparatus, chemicals, and instructions for making all these tests in the home



TESTING NICKEL-PLATING. Treat the surface of the article with a drop of concentrated hydrochloric acid, place a crystal of methylamine hydrochloride close by, and heat. A blue spot will appear where the acid was applied if the plating is nickel. The color will disappear on cooling

Household Health and Economy

Tests devised by I. Newton Kugelmass,
Professor of Chemistry, Johns Hopkins



COPPER SULPHATE is sometimes used to make bottled pickles and canned peas a beautiful green. Place an iron nail in some of the vinegar. If the nail becomes copper-coated after being immersed for an hour or so, the pickles contain a dangerous amount of copper.



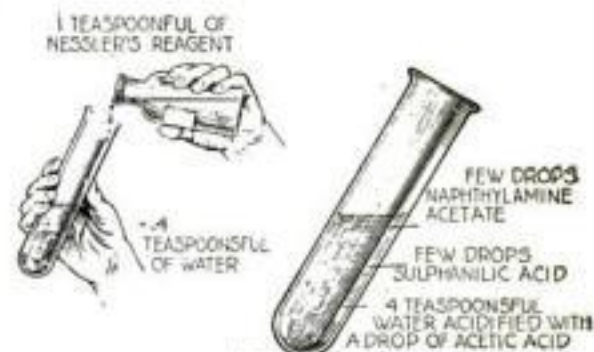
GROUND COFFEE will float on the surface of cold water if pure and sink if adulterated. On shaking the coffee in a saturated solution of common salt, the coffee is pure if nearly all floats and the liquid is pale yellow.



FOOD PRESERVATIVES. Acidify and shake the solution with ether. Separate the ether layer and let it evaporate. Dissolve in hot water, add a little ammonia, and drive off excess by heating. Add a few drops of one per cent ferric chloride solution. A brown precipitate indicates benzoic acid or sodium benzoate. A violet color means salicylic acid.



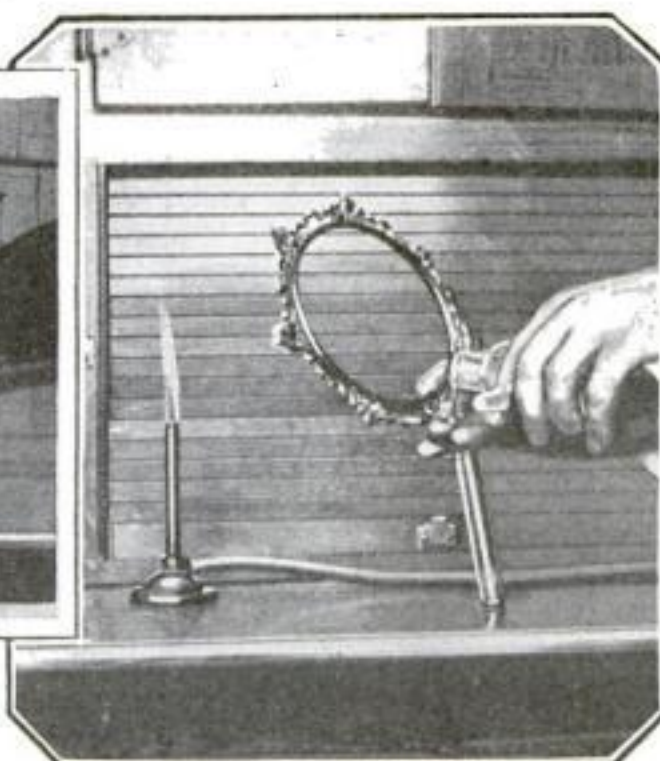
TESTS FOR MIXED FABRICS containing silk, wool, cotton, and linen. All department-stores and manufacturers use these tests in buying, and they are so simple there is no reason the housewife should not make them herself and be sure she has her money's worth. Simply dissolve a sample of the cloth in the various reagents.



PURE DRINKING-WATER. Try these tests if you have any doubt, and have the water analyzed by a chemist if they are positive. A deep color or turbidity after the first test indicates animal contamination. Stir the contents of the second tube with a glass rod, and if it should turn red, the water is dangerous.



SILVER-PLATING is determined by touching the article freed from grease with a drop of concentrated nitric acid, and absorbing the latter with filter paper. Treat the spot with a drop of formaldehyde and sodium hydroxide. If it turns black, you may be sure it is silver.



TESTING GOLD-PLATE. Rub with a piece of glass-paper, place the paper in a test-tube, and warm it with aqua regia until the metal is dissolved. If it is gold, a few drops of stannous chloride will turn the solution violet.



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He Played the Piano for Over Two Days

PICTURED above is Mr. J. M. Waterburg, of San Francisco, who won the piano marathon race. He played the piano for sixty-five hours, twenty-five minutes, and thirty seconds without once stopping. During that time he did not move from his seat nor take his hands from the keys. An attendant fed him sandwiches and large cups of black coffee at regular intervals. However, when the race was over, he felt exhausted, over the keyboard.

Sixty-five hours is more than two and a half days and nights, and yet Mr. Waterburg is not satisfied. He is going to try some time in the near future to beat his own record.

Wed in Balloon by Wireless

LYING before this Los Angeles clergyman is a book that is open at the wedding ceremony, and he is marrying a couple floating in a balloon thousands of feet above his head.

In this ultra-modern marriage a wireless telephone was used to make the responses audible, and when Mr. and Mrs. Ramsay stepped out of the airship, they were man and wife. The best man accompanied the bridal pair to hand the groom the ring and to act as witness.

If the Ramsays had friends who intended to shower the couple with rice, they avoided them very neatly, for when they descended they were well on their honeymoon journey.



This Open-Center Bit Speeds Boring

AT the end of this auger bit is a groove hollowed out of "open," instead of closed, as in the usual type. As a result of this improvement the shaving comes out in perfect shape and is carried up and away from the operator. The machine disposes of chips so there is no clogging.

AIRPLANES without pilots, flown and directed by radio from ground stations, have made successful flights. Radio is playing a large part in the equipment of military planes, not only for ground or air communication, but for direction finding and landing in fog or darkness.

LARGE logging gin-poles and donkey-engines are generally used in Vancouver to pull stumps, writes H. M. Burwell, consulting engineer. The gin-poles are of sufficient length to enable logs and stumps to be piled in a radius of fifteen hundred feet, in piles often one hundred feet in height.

A patent grab-hook attached to the stump allows it to be released without keeping a man on the pile for this duty.

Gravel Scratched by the Cubic Yard

THE hoist illustrated below has effected great economies in operating dragline outfit in gravel-pits. It is a great time- and labor-saver, as the gravel is dug, lifted, screened, and sorted ready for delivery by one machine in a single operation.

The hoist is run by an internal-combustion engine using either kerosene or gasoline for fuel.



Gravel moves from the pit to the wagons in forty seconds



Making Cigar-Lighters from Shells

EMPTY shells, gathered from the battlefields, are being turned into cigar-lighters. The hollow-shell is filled with kerosene and a wick is placed in it. A tooled wheel for producing the spark is attached to the shell by a bracket.

As the wheel rotates, sparks fly, and lights the wick.

THE age of some fish, notably herrings and salmon, can be ascertained by counting the rings on their scales. The rings are similar to those on trees, and are produced by virtually the same cause. Neither the scale nor the tree grows much in winter.



Fireproof Shoes for Mill Workers

AN asbestos shoe has been invented for those who work in steel mills amid molten or red-hot metals.

This shoe, it is claimed, will protect the feet thoroughly, wear indefinitely, and may be quickly kicked off in case of emergency. The uppers are made of the same material as the fireproof curtains used in theaters, and are soft and pliable. The lining is of cotton or cotton flannel, both of which materials act as non-conductors of heat, while the soles and heels are of the same material as brake-band lining on automobiles.

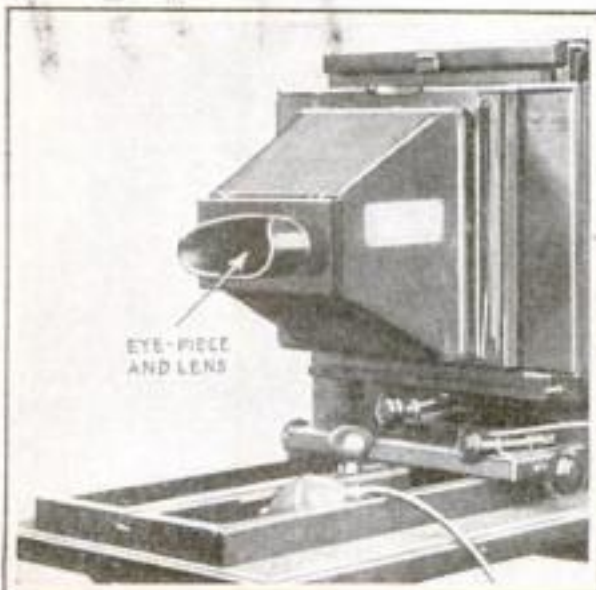
The shoe slips on like a slipper, having neither laces nor clasps to catch and retain molten metal, and have been found more practicable than any leather shoe.

Lens Replaces the Focusing-Cloth

PUT this attachment on your camera and throw away your focusing-cloth, for the hood-supported lens will not only exclude all light, but magnify the image shown on the ground glass and allow the photographer to see exactly how his picture will appear when finished.

The appearance of the black cloth is usually the signal for the subject sitting for a portrait to put on a "photographer's smile." With this simple focusing method, the portrait can be snapped after inserting the plate-holder, before the sitter loses his natural expression.

The magnification of the image also eliminates the eye-strain.



No focusing-cloth needed and no more eye-strain

This Amplifier Made a Concert Audible Three Miles Off

EXECUTIVE officers of the American Telephone and Telegraph Company are amusing themselves with the world's largest sound-amplifier, located at Yama Farms, New York. They talked with Chicago over the regular telephone wires while standing fifteen feet away.

Tests showed that an ordinary speaking voice and the strains of an orchestra playing in Chicago and transmitted over the wires could be heard three miles away when the amplifier was operated at full capacity.

This great power is the outcome of study of the best device for fire and air-raid alarms.

Has the Earth a Steel Core?

BECAUSE the ocean is fluid while the solid crust of the earth resists deformation by the gravitational forces of the sun and moon, tides are produced. Dr. Miller, of the Royal Astronomical Society of Canada, has stated that the fact the earth does not yield to tidal forces proves that the interior of the earth cannot be liquid, since the thickest crust would be deformed by tidal movements. He suggests the center of the earth must be solid and strong as steel, and that volcanoes and the high temperature in deep mines are due to the presence of a thin molten layer between the center and the outer crust.

ADVERTISING SPACE

Tagging the Hotel Room Key

HOTEL guests often take their room keys with them when they leave. This carelessness causes the proprietor considerable trouble and waste of time. In behalf of hotels in general, Mr. J. C. Webster, of Topeka, Kansas, has invented a key tag that cannot be removed. The tag makes the key such a clumsy thing to carry that a guest will invariably leave it at the desk when he goes out.

The tag is made of leather and has two isinglass faces; cards carrying advertising can be inserted through a slit in the bottom.

It was difficult to obtain accurate measurements of the tensile properties of boiler-plate at high temperature under rapidly varying stresses, because one man could not read six rapidly changing dials simultaneously. Mr. H. J. French has obtained accurate figures with the aid of a motion-picture camera.

The dials are placed close together, and however rapidly their readings alter, the moving-pictures preserve a record.

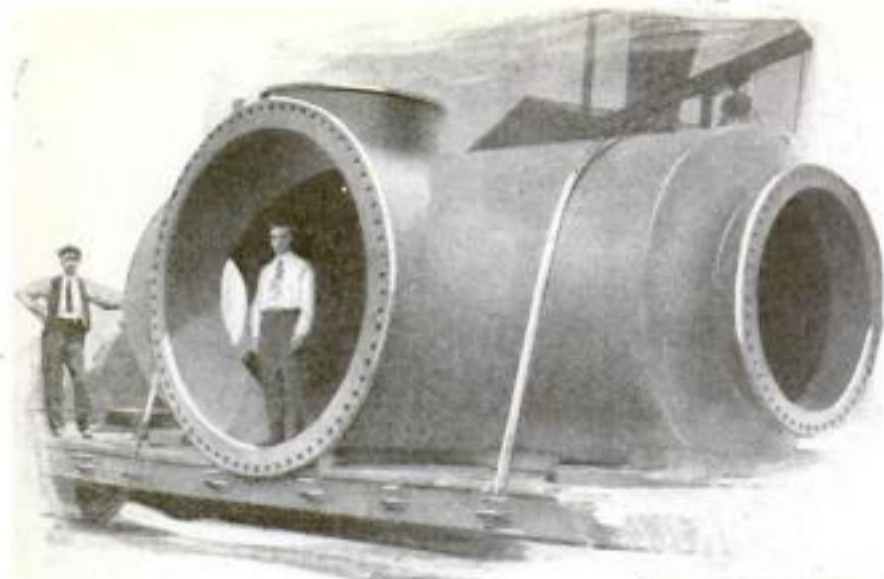
She Has a Real "Spring" Step

THE simplest way to exercise the legs is to walk. But some people make things hard for themselves—as, for example, the Englishwoman whose legs are shown in the picture below. She needed exercise and, instead of walking, rigged up the spring and tape attachment shown.

She stands on one foot and waves the other in the air—the spring making this difficult to do.



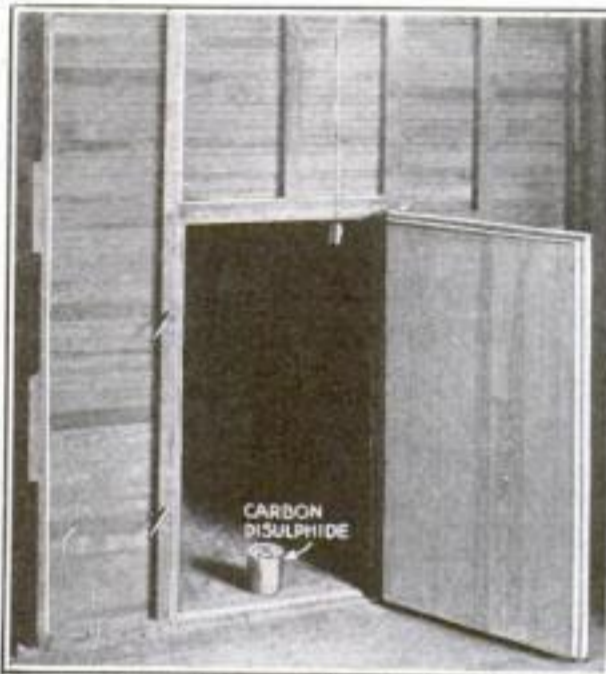
She's taking walking exercise with a spring



World's Largest Welds by Village Blacksmith's Methods

AMERICAN manufacturers are turning out far larger and more difficult welding jobs than the best work done abroad. The illustration shows three-way pipe-fitting, over six feet in internal diameter, made by the arc weld process.

The welds in this fitting are forged by a method similar to that used by the blacksmith, except that instead of a forge a gas flame is used for heating, and instead of a sledge, large automatic hammers force the metal together. Such welds are both stronger and more impervious than the butt or scarf welds of the oxyacetylene process.



Gastight Room Used in Killing Off Pests

FARMERS sustaining losses from weevil-infested corn can well duplicate the example of a wholesale grocer in Florida, who has built a gastight fumigating-room for waging war on weevils. The Bureau of Entomology, United States Department of Agriculture, emphasizes the menace of the insects, recounting that Florida alone suffers a loss of 1,260,000 bushels or 10 per cent of its corn crop annually.

The door of the fumigating-room is wide enough to permit of the entrance of trucks loaded with corn. While the deadly poison, ordinarily carbon disulphide, is being applied, two clasps hold the door tightly, so that none of the dangerous fumes escape.



Elephants' Saturday Night Comes Once a Year

ELEPHANTS of the New York zoo are given salt-water baths once a year. But when the bath-day comes, they thoroughly enjoy themselves.

This herd was taken into the surf at Coney Island, and like all the rest of the bathers, started to play ball. For a ball they used their keeper, who enjoyed the sport as much as the elephants, though it came rather as a surprise to him and was a little strenuous.

Men who have had experience with the great creatures affirm that they are very loyal, once they know a man is their friend and will do his bidding willingly.

An Amphibious Automobile

THERE is nothing particularly startling nowadays about an automobile that will travel in the water like a boat, but this French invention being demonstrated at Marseilles is not designed for a stunt, but as a practical vehicle for colonies and districts crossed by a network of rivers where there is not enough traffic to justify expensive bridge-building.

The feature of this machine is its large size.

It was demonstrated with a load of seven passengers and nearly half a ton of freight, and in spite of this load it climbed down a bank, crossed a stream, and climbed up the opposite shore without the slightest difficulty.

Signing Checks by a Finger-Print

A NEW YORK bank on the East Side has so many depositors who are unable to sign their names that it has adopted the finger-print system for their convenience and protection. Depositors who wish to withdraw money rub their thumb on an inked pad and stamp the imprint on the check instead of signing it.

A finger-print cannot be forged, and the old legal method for the illiterate which required them to sign by making their mark in the presence of two witnesses was very slow and open to some abuses. The tellers write the name of the depositor under the print, but the finger-print is always the decisive evidence.

© Kadel & Herbert



French automobile, designed for undeveloped country, travels on land and water



Illiterate depositors in this New York bank sign checks by a thumb-print



Carry Enough Fuel in Your Pocket to Cook a Meal

YOU can boil a kettle without fuel, even without a stove. All that is needed is this new French invention, which is the most compact heating arrangement on the market.

It is called a "pencil," and looks like one, but it is filled with a slow-burning compound which gives off intense heat. In action it looks like an oxyacetylene flame, but it is guaranteed not to take the bottom out of the kettle.

This "pencil" may be carried in the pocket, and when ignited it will burn for a long time and bring a kettle of water to a brisk boil in four minutes.

To reduce the danger of gas explosions in coal-mines Dr. G. Harger has suggested charging the atmosphere with flue-gas, which contains little oxygen. Research indicates that the scheme is impractical, since, for one thing, it would be difficult to free the flue-gas from the fatal carbon-monoxide, or fire damp, and because experiments of T. J. E. Rhead show that an atmosphere of 17 per cent oxygen, the lowest in which men can work, will still form an explosive mixture.



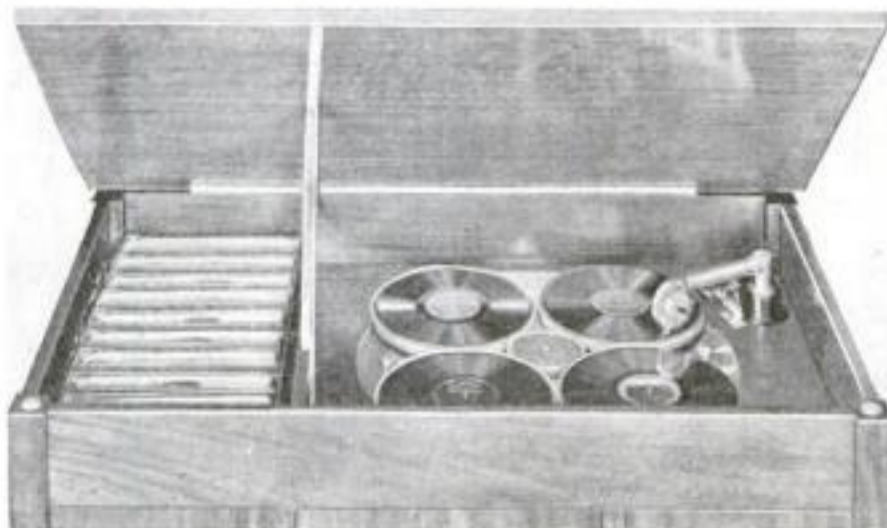
Roaring Up a 70-Per-Cent Grade

TO obtain traction for a standard touring-car up a seventy-per-cent grade on Signal Hill in Long Beach, California, a plank runway was laid up the side of the hill, and holes were bored in it. Then a steel rim with knuckles or cog was constructed, the circumference of the cogged rim being a little less than that of the deflated tire. The rim was then put on over the tire and the tire inflated to hold the rim firm. The cogs fitted into the holes in the planks.

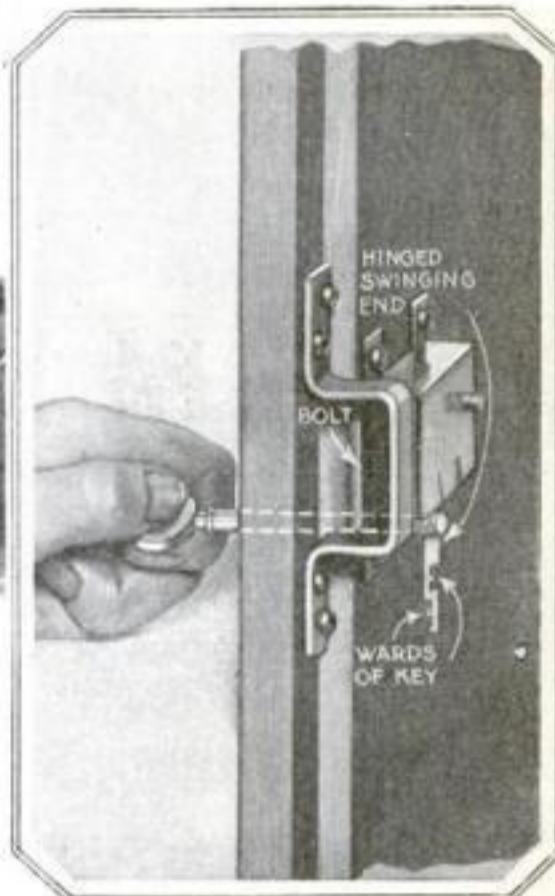
It Plays Four Records in Succession

HERE is a phonograph that is so constructed that four records can be played successively without any assistance from an operator.

An electric motor turns a small central disk that presses against four turntables, causing them to revolve. Then the needle reaches the end of the first record, the arm automatically rises and the main table that carries the four turntables swings around so that the second record is in playing position. The arm drops and the music continues.



You can dance through four records without having to set the phonograph

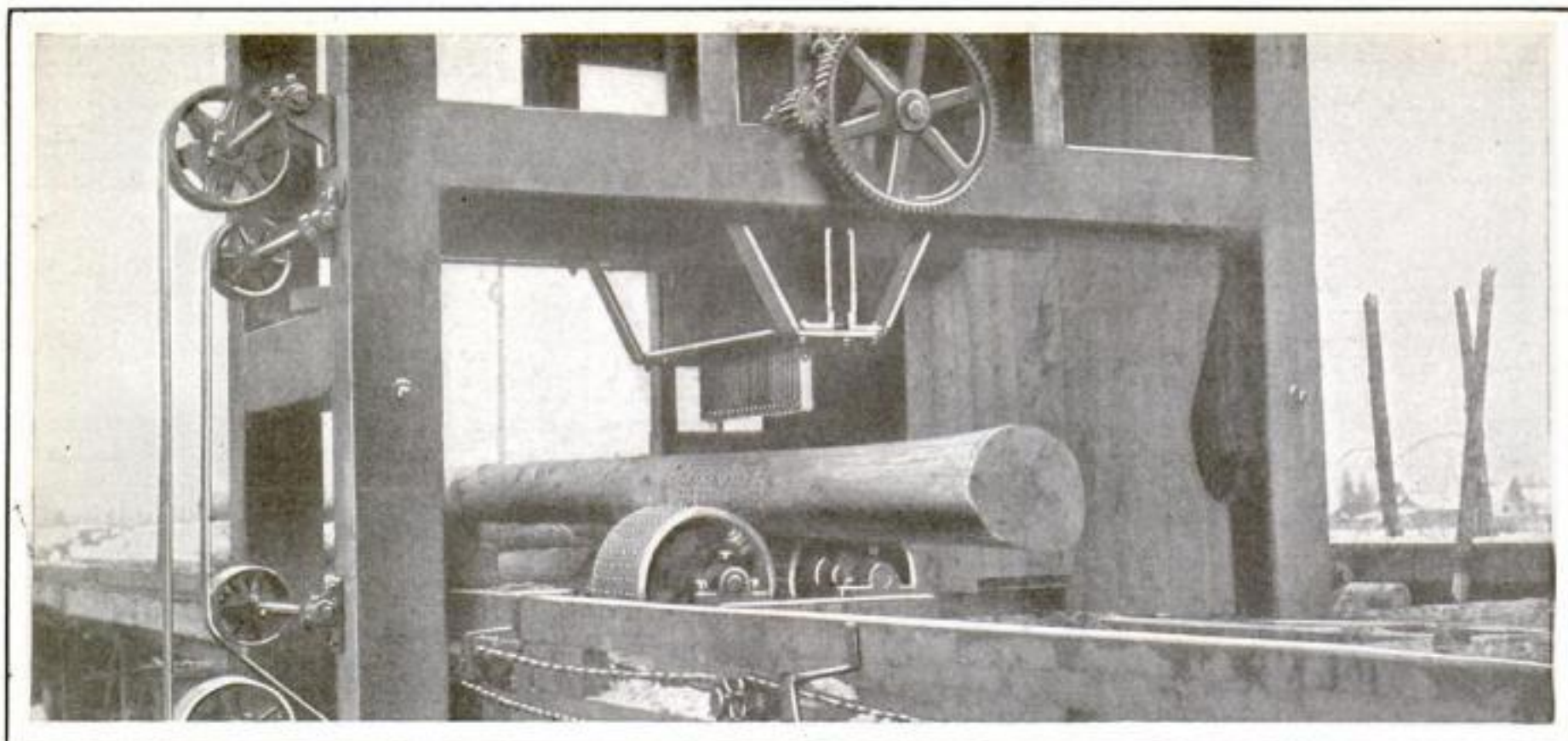


A Burglar-Proof Key that Swings in the Lock

MOST keys are rigid, but here is one that has a hinged and swinging endpiece. You insert the key in the keyhole and the endpiece drops down. Then when you turn the key, the swinging section describes a circle, passes through grooves, and strikes against a metal knob attached to the bolt. As it presses against the knob, the bolt moves and the door becomes locked. It can be unlocked from the outside by swinging the key in the opposite direction. There is a knob on the end of the bolt that enables you to lock and unlock the door on the inside by hand.

No burglar's skeleton key could negotiate this lock.

THE potential passenger business of airplanes depends upon suitable landing-fields near large cities, says Professor Warner, of the Massachusetts Institute of Technology. The air-time between New York and Boston is only three hours as against five by train, but if the plane must leave from Framingham and arrive on Long Island, no time is saved, because the landing-fields are too far from the cities.



A Machine for Punching Holes in Poles before Creosote Is Applied

PUNCHING uniform holes in red cedar telegraph-poles is the job of the machine shown above. The holes are filled with creosote—a preservative that will lengthen the life of the poles.

Forty-two iron bars four and a half feet long, three inches wide, and three quarters of an inch thick are enclosed in an oblong case. Each bar carries at its bottom end a detachable point holder; thus the depth and spacing of the punctures can be regulated. The bars are raised by cams until they reach a certain

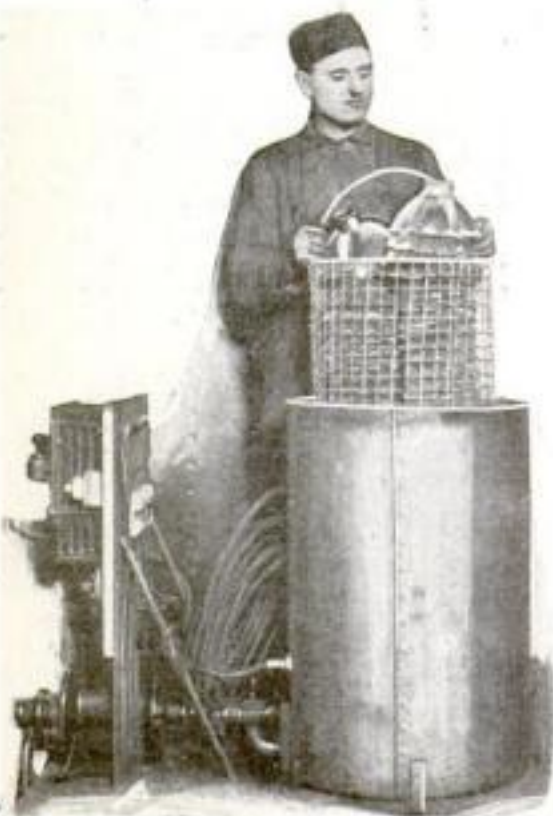
height. When released they drop independently on the log. They are impelled by gravity; hence they hit the log with equal force and penetrate to the same depth, regardless of all the surface irregularities.

When one set of punches are made, the log is rolled over by two metal wheels, and a second set is made. This is continued until there is a complete circle around the log. The circle is made where the pole will meet the ground when it is set up.

How Glass Lamp-Shades Are Washed Electrically

THE glass-shade washing machine consists of two galvanized iron tanks, a washer and a rinser. The washer is equipped with a propeller that hurls the water against veins that direct the flow so as to throw the water up through the shades and down over them again.

Sixty shades are placed in a wire basket, which is then lowered into the washer. The water is heated electrically. In the rinsing-tank ammonia is added to the water, which gives luster to the shades.



It washes sixty glass shades at a time



Automatic Indicator of Salt in Boiler Water

WHEN the salt in boiler feed water rises to a percentage that threatens damage to the tubes, a lamp, connected with the device that is illustrated above, lights. The more salt there is in the water the brighter will the light burn.

Engineers at sea are accustomed to make an analysis for salt in boiler water at least once a week, but it is a complicated process and not as accurate as it might be, since, obviously, it would be hard to perform delicate chemical manipulation in a howling gale.

This indicator is constructed on the principle of electrolytic action, and it constantly analyses the water. As long as the little electric light does not glow, the engineer has only to look at it to be sure the boiler water is all right.

This Drawing-Board Stand Can Be Folded

A DRAWING-BOARD stand is usually a clumsy affair that occupies a large amount of valuable space. When it is not in use it should be tucked away. Hence we now have a new collapsible stand that can be folded up easily and put in the corner, out of the way, like any ordinary folding table.

The stand is made of metal and is in two pivoting sections. When the stand is opened, the drawing-board is fastened to one section and hooks on to a rail across the other section.



When not in use, this drawing-stand folds up

This Cigarette-Holder Ejects Its Own Butt

IF a cigarette burns to the end, it is difficult to take it from the holder while it is lighted, and yet it is something that is happening constantly when a group of men become interested in an argument. Here is a new holder that is made in two parts. One part slides within the other.

When the holder is held as shown in the illustration below and pressed with the thumb, the cigarette butt will be ejected into the ash-tray. A small spring arranged between the two parts of the holder brings the movable end back into position.

In the future it will not be necessary to pull the butt of the cigarette out of the holder either with a toothpick or with a pin.



Push the holder and the butt is ejected

Sanding Slippery Streets

A MACHINE not unlike a street-watering machine has been invented for sprinkling sand on icy pavements. The sand is in a tank and is fed to rotating distributors that hurl it on to the street. The amount hurled and the area covered depend upon the speed at which the distributors rotate. This is controlled by the driver.

In the picture you see a sanding machine in use. It has eliminated ninety-five per cent of the accidents caused by slipping and skidding.

The same machine is also used for removing oil from the streets. The sand mixes with the oil and is then washed off.



Sprinkling streets with sand instead of water in order to prevent skidding



Gasoline-Driven Trains

GASOLINE-PROPELLED motor omnibuses have been installed by the Government to provide regular train service for Camp Allen A. Humphreys, Belvoir, Virginia. The steam equipment formerly adopted required the services of a large train crew, while the new coach is handled by one man.

The four-wheeled truck under the engine is a new departure in railway design. It can be steered. The coach may be used on an ordinary road simply by changing the steel wheels for rubber tires. It may be used for omnibus service in the country, and in cities provides a car like a trolley, but needs no tracks.

An Incubator for Every Baby

"WHAT'S good for the chick is good for the child." Such is the opinion of the Frenchman who invented this electric incubator for the baby, which he claims is simple enough to be used in the home, and a great benefit in the critical first weeks of the life of a delicate infant.

The heating coils are enclosed in the double cover, and may be adjusted for four temperatures. The air supply comes through the base of the incubator, and rises through two chimneys set in hollow corners of the walls. A regulating thermometer set near the baby's head maintains the temperature at the point prescribed.



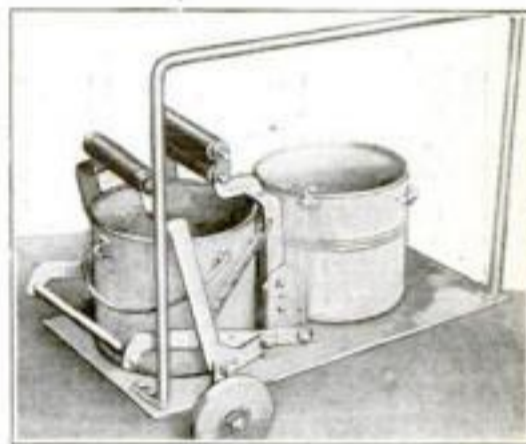
Every home can have its baby-incubator

Wheel the Mop and Pail from Place to Place

RATHER than carry the mop, the pail, the wringer, and the soap from place to place, the men in a railway toolroom constructed the truck shown below. Thus, when they wish to clean up a greasy corner of the room, they wheel the implements to the spot.

The floor of the truck is a thin steel plate, and it is mounted on three wheels—two on an axle at one end and a lone wheel in front. There is a handle that extends down one side of the truck; this is used for pushing, and it also acts as a support for mop and broom handles.

The truck is of a design that would be valuable to women in the home and for those who have to clean offices, saving many steps in the day's work.



Railroad men invented this cleaning-truck

Roads Speedily Resurfaced

CLOSING London's busy roads for several days while they were resurfaced was inconvenient and interfered seriously with traffic. A new method permits the road to be completely repaired and opened to traffic again three hours after the repair crew goes to work.

Tar is vaporized in a traveling cart and pumped through the sprayer at high pressure, which forces it deeply into the bed of the road.

While the tar is still hot, there are men following behind the sprayer to sprinkle fine gravel over the surface, and as soon as the tar hardens, which takes only three hours, as stated above, the road can be thrown open for traffic.

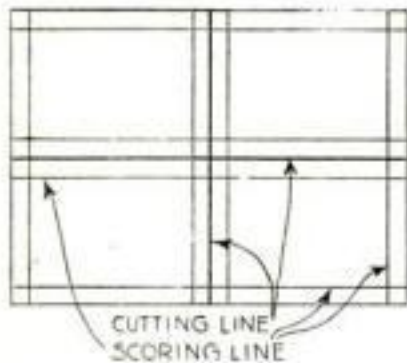


Pressure-spraying with hot tar repairs roads in three hours

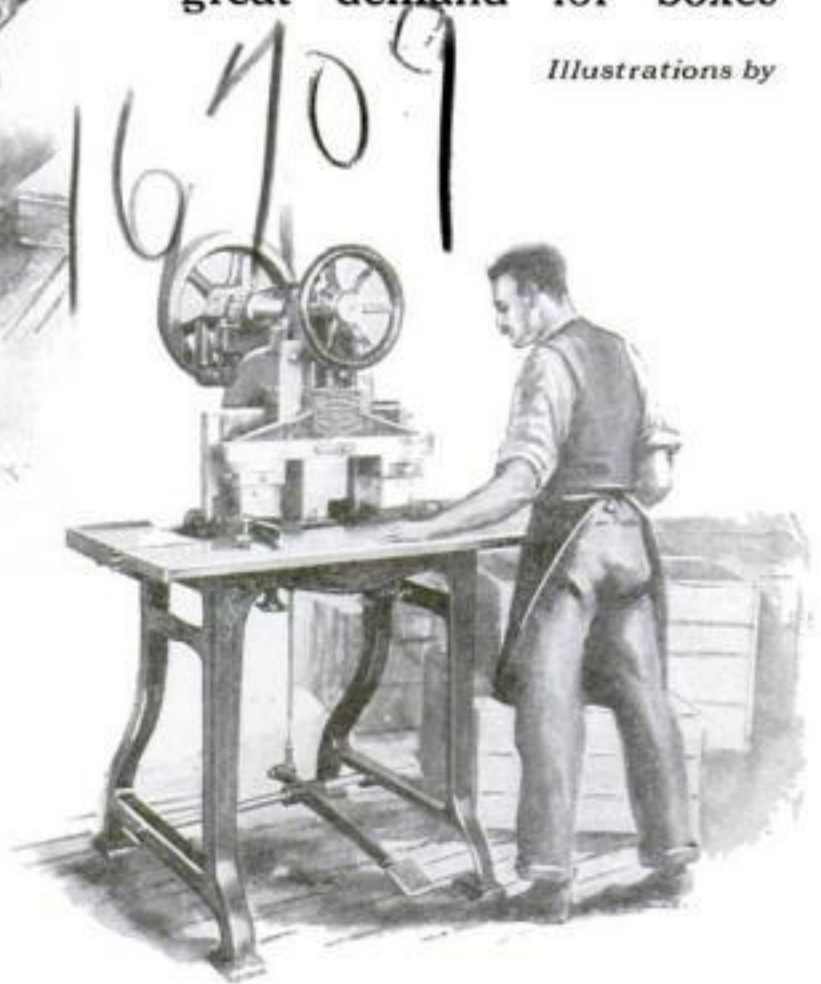
The Machines that

Even automatic machinery can scarcely supply the great demand for boxes

Illustrations by



The first machine scores the boxboard from which four boxes will be manufactured. The cuts are made on the unlined side of the paper, which will become the outside of the box. The scorer cuts the blanks both lengthwise and crosswise at one operation, and the cutters are adjustable so that any size of box may be turned out on the same machine



No Rush-Hour Scramble on Paris Buses

THEY have their rush-hour and their strapangers in Paris, too, but, thanks to the very simple machine depicted below, the rush-hour never degenerates into a more or less good-natured, free-for-all fight, in which the men push their way into the cars and the women are forced to stand aside until the rush is over, or dash into the crowd at great peril to their millinery.

No, even in the rush-hour the Parisians get on the car in the order in which they reach the platform. It is very simple. A little machine is attached to a post at the point where the car is to stop. As you pass the post, you tear off

a numbered piece of paper from the pad. The machine is devised so that it will issue only one ticket at a time, and all tickets are numbered consecutively.

When the car stops, the passenger



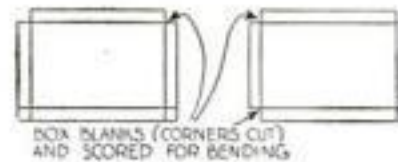
With this machine, Parisians reserve a seat on the bus in the order of their arrival

who thinks he arrived first calls out his number. If any one has a lower number, he shows it, and is allowed to get on the car first. The other passengers

follow him in the order of their slips. If any one has lost a slip, there is liable to be some confusion.

This simple system works splendidly in France, and, after a little preliminary education of the public, it might save a good many tempers in the United States. The device is new in Paris, but an even simpler affair, a numbered pad attached to a telegraph-pole, has been in use in Bordeaux, and other cities in the south of France for many years, and while French trolleys are often badly crowded,

there is seldom any confusion in getting aboard. The crowds are as great as they are in the United States, but after getting their little slips they line up on a car platform just as we do for a railroad ticket-window.



The small sheets then go to the double-corner cutting machine, which removes two corners at a time from a pile of twenty-five blanks

Green Frogs that Are Blue; Blue Birds that Are White

A CORNELL professor, W. D. Bancroft, declares that the green tree-frog has no green pigment. His color is like that of the green eye, and is due to the blue of a turbid medium with a yellow pigment over it. If the green Australian tree-frog is put in alcohol, the yellow pigment is dissolved and the frog turns blue.

The apparently blue feathers of the kingfisher, the indigo bunting, the blue jay, and the bluebird are brown when the light comes through them, and contain no blue coloring matter at all. There is a strip of dark pigment, and above this a layer of tiny air-bubbles, about 1/200,000 of an inch in diameter, say forty billion to the square inch. These air bubbles reflect the blue light, and let the red and yellow rays pass through to the dark background, where they are absorbed.

A certain South American blue bird, according to Louis Agassiz Fuertes, turns white when it becomes wet, but resumes its blue color when it is dry.

Make Candy-Boxes

The United States alone ate one billion dollars' worth of candy last year

Robert F. Salade



The outside corners are then stayed with gummed paper. One corner is glued at a time, the operator turning the box for each operation

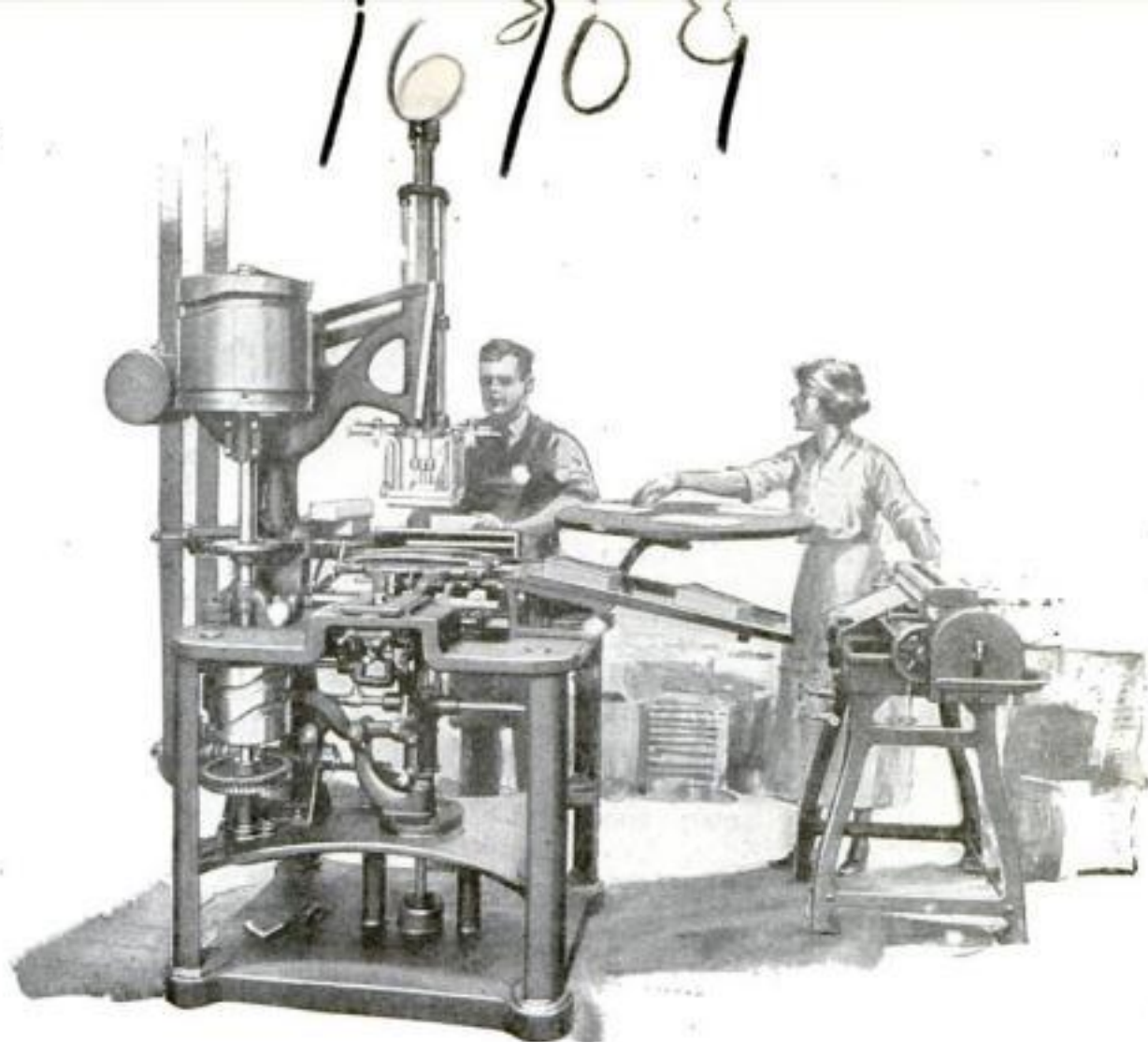


Gluttons Eat Sixty Pounds of Food a Day

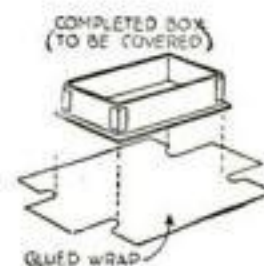
THE exploits of the gentlemen who eat ten dozen raw oysters at a sitting or a dozen beefsteaks at a meal seem moderate, even abstemious, in comparison with the food consumed by the greatest gluttons of medical records.

A man who eats a whole leg of veal for dinner must have a fair appetite, but the records of the Royal Society mention the case of a boy ten years old who consumed sixty-four pounds of food a day for a week. Another case, also a young boy, averaged over 374 pounds a week for more than a year. Even then he was always hungry, and if food were not supplied him, he would gnaw his own flesh.

Such appetites as these are a disease—diabetes. In spite of the food taken into the stomach, the body gets no nourishment, and these boys were really starving while they sat at table with piles of food in front of them. Both died emaciated, as if they had starved to death.

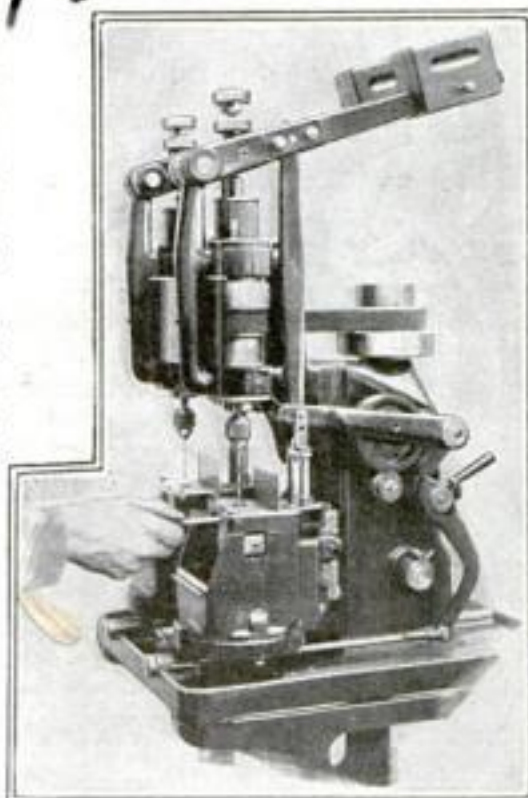


The fancy paper has been cut and gummed. The box is placed in the proper position on the wrapper and fitted on the form of the machine. It then passes through a series of brushes and rolls, which draw the wrapper close to the box and fold in the paper at the corners and ends. As the machine makes a complete revolution, the box emerges finished



Machine Warns when Drills Are Dull

DESIGNED for rapid production without the need of expert attention, this two-spindle automatic drilling machine uses the gravity feed. Adjustable weights apply a constant uniform pressure to the drill, and a friction control holds the drill to a maximum downward speed and then raises it rapidly. eccentric, and slipping ensues until the drill-point breaks through the work, when the thrust is again taken by the eccentric and the spindle held to the maximum feed.



Showing insertion of work in the automatic drilling machine

The control mechanism consists primarily of a grooved eccentric held in contact with a revolving roll. The eccentric is mounted in a lever connected with the weight lever that applies the gravity feed to the spindle. Whenever pressure is applied to the eccentric, it is revolved by the roll and directs the movement of the lever. When the weight thrust is taken at some other point, as when the drill strikes the work, pressure is removed from the

Although the two spindles are driven by one belt, they work independently. The fixtures can be made for any class of work and can be operated directly by foot lever, which gives the operator nothing to do but set the piece in position and press the spindle release rod. If a dial or other automatic feed device is attached, the release rod may be locked and the drill operated continuously. Production depends on the speed of the operator.

When the drill gets dull, the spindle control automatically shuts off. This is accomplished by a timing device which throws a catch lever if the drilling extends beyond the time set.

This Andalusian Hen Changed Her Color from Blue to White

A BLUE Andalusian hen, for no apparent reason, began to change color; at each molt blue feathers disappeared and pure white ones filled their place until at the end of eleven months she was snowy white. This fact is strange, but stranger still is the fact that many of the chicks that she hatched after she changed color were blue! Thus genetically she remained the same in spite of her complete color change.

What was the cause of the change? No one has been able to find out. It was not due to loss of pigment after growth, since the blue feathers remained blue until they fell out; the new ones coming in were white. Today the hen is apparently in the best of health and occasionally lays eggs. Three years have passed since she became white, yet she shows no tendency to return to her former color.

The life history of this hen is interesting. She spent the first two years of her life in the poultry-yard of the University of Wisconsin; her ancestors were very much pedigreed, and nothing unusual appeared in the family history. In August, 1917, at the age of two years, she was transferred to the Kansas State Agricultural College and



In spite of her white feathers, and even when bred to a white Wyandotte, her chicks are blue



A blue-barred and a black-barred chick that were hatched after the mother turned white; their father was a white Plymouth Rock



Pictures by courtesy of the *Journal of Heredity*

In less than a year this blue Andalusian hen turned snowy white. This picture was taken two months after the change

was placed under the care of Mr. William A. Lippincott. Two months after her arrival her feathers began to grow in white!

While she was partly white and partly blue she was mated with a white Wyandotte. Twenty-eight chicks were hatched, of which thirteen were blue and fifteen black. Later, when she was pure white, she was mated with a white Plymouth Rock. Ordinarily two white parent birds would produce all white chicks; but in this instance none of the chicks was white—some being blue and others black.

Modern Automobile "Prairie Schooners"

CARAVANS of pioneers still travel the overland trails to the West to take up "quarter sections" of farm land, but instead of the primitive, slow, uncomfortable prairie schooner, the new settler uses an automobile and camps comfortably along the road in a compact outfit carried on a trailer.

The trailer outfit is a very complete home on wheels, with every convenience except running water, and plenty of room for everybody. It is enclosed with automobile-top material, which is waterproof and folds into a small space, and the equipment provides two cot-beds with good springs,

a smaller bed for the youngster, screens and shades for the windows. The minor conveniences comprise folding stoves, tables, and chairs, and a collapsible bathtub, washstand, and buckets. The bungalow can be erected in ten minutes.

All these items form a series of units which are packed neatly on this model trailer, which has the capacity of a light truck. The trailer has a steel body with wooden automobile wheels and ball bearings and pneumatic tires, so that it travels at any speed over any sort of road.

Such a camping outfit as this should

appeal to those motorists who like to follow the unbeaten pathway and who prefer the spots far from the traveled road, for the new trailer makes it possible to adventure into the byways and revel in beautiful spots, little known to the average touring motorist.

Now We Have the Life-Saving Deck-Chair



Not content with being a life-saver, this chair may be a wash-stand

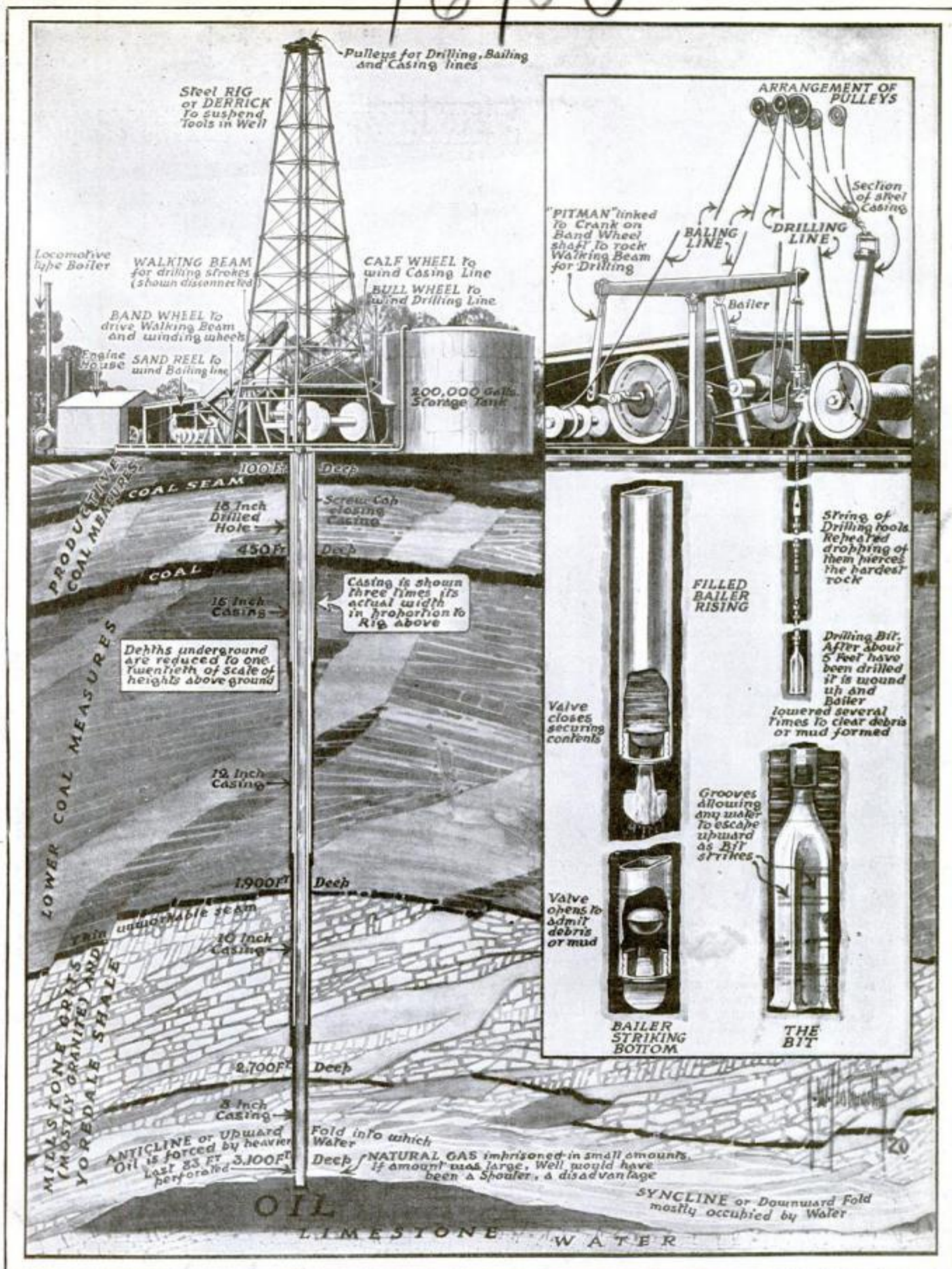
HERE is the ideal chair for boats. It is cushioned and comfortable for fine weather, but in an emergency it may be thrown into the water and will support a person until help arrives.

In case sleeping accommodations are overtaxed, the lacing may be undone, and you have a mattress. In the morning, turn the chair upside down, fasten a canvas bag to the feet, and the chair is converted into a wash-stand.



Here is a trailer being made ready for the night; it will accommodate a family and can be put in order in ten minutes

16956



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Drawing by S. W. Clatworthy

First Successful Oil-Well in Great Britain

FORTY American drillers were employed to sink the first English oil-well, which is located at Chesterfield, Derbyshire. Oil was discovered there, to the astonishment of the inhabitants.

The Hardstoft well produces a weekly output of 250

barrels of thirty-five gallons each. The geological formation is shown in the drawing, also the apparatus. At the right may be seen the well-sinking machinery.

Should the supply of oil fail, the drillers are prepared to extend the casing down to four thousand feet

Finding New Uses

A few of the thousands of answers received in the Popular Science Monthly's competition



Every housewife wants a cedar chest and a cedar chest happens to be expensive. Frederick Sprague found an old trunk in the attic, lined it with red cedar shingles and made a chest as moth-proof as any that can be bought



Harry B. Wilson, winner of the second prize, has found a new use for old newspapers. He grinds them up into a pulp and molds them into ornamental forms for decorative purposes. (See Home Workshop Department for description)



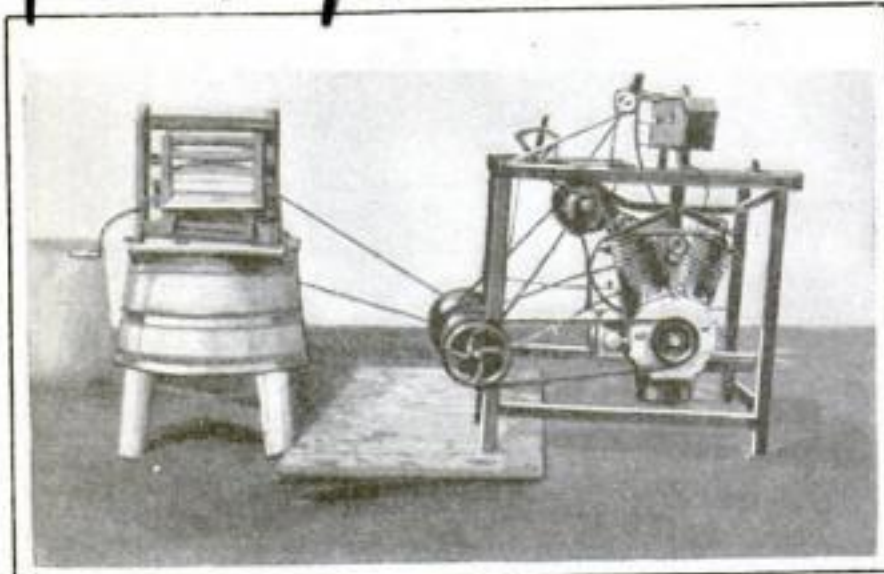
An old desk 'phone can be changed into a student's lamp. Leroy V. Muldner, the "inventor," warns the readers of the Popular Science Monthly to use only a 'phone that belongs to them. Company phones are barred



Every junk-yard has a number of old kitchen sinks resting in the pile. Fifty cents will buy one. They make very good flower-boxes. This is the idea of G. E. Black



The wicker top of an old doll-carriage found a new and attractive use when Jean B. Jones trimmed the inside of it with cotton and used it as a sewing-basket. The illustration shows just how the renovated carriage top appeared



Edward Ludwick found a use for his motorcycle engine. He made a family power plant of it. It drives the washing-machine and the churn, and supplies the house with electric light



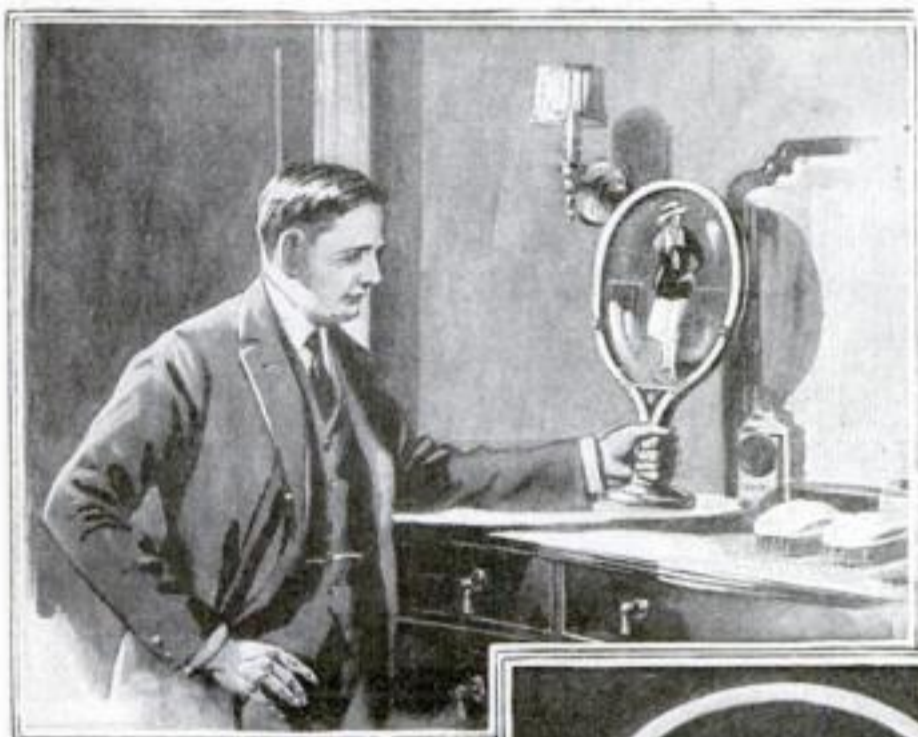
A velvety black photograph record, though it is old, may be used as a clock-face for a homemade grandfather's clock. Charles A. Neilsen made such use of an old record



Ralph H. Leffer found that he could change an old cream-separator into a useful forge that saved a lot of money through the aid it offered in the repairing of farm machinery

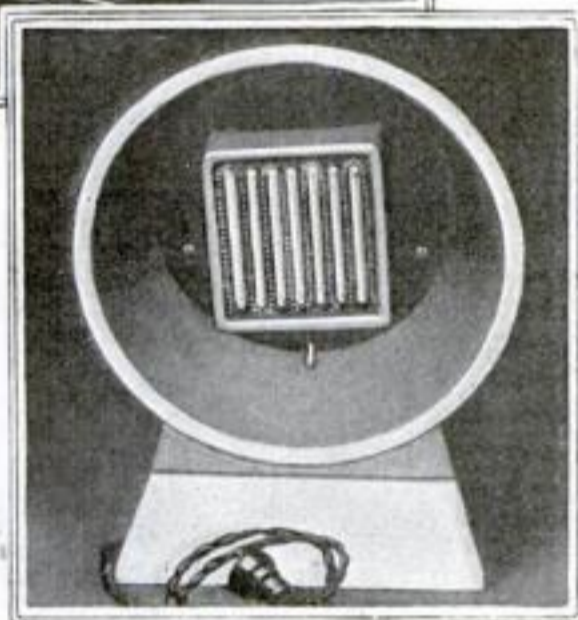
for Old Things

Showing how our readers used odds and ends to make objects of value for farm, home, and shop



Why not use a tennis-racket for a picture-frame? That is what C. L. Meller, a Popular Science reader, did. Just the thing for the den or the college dormitory.

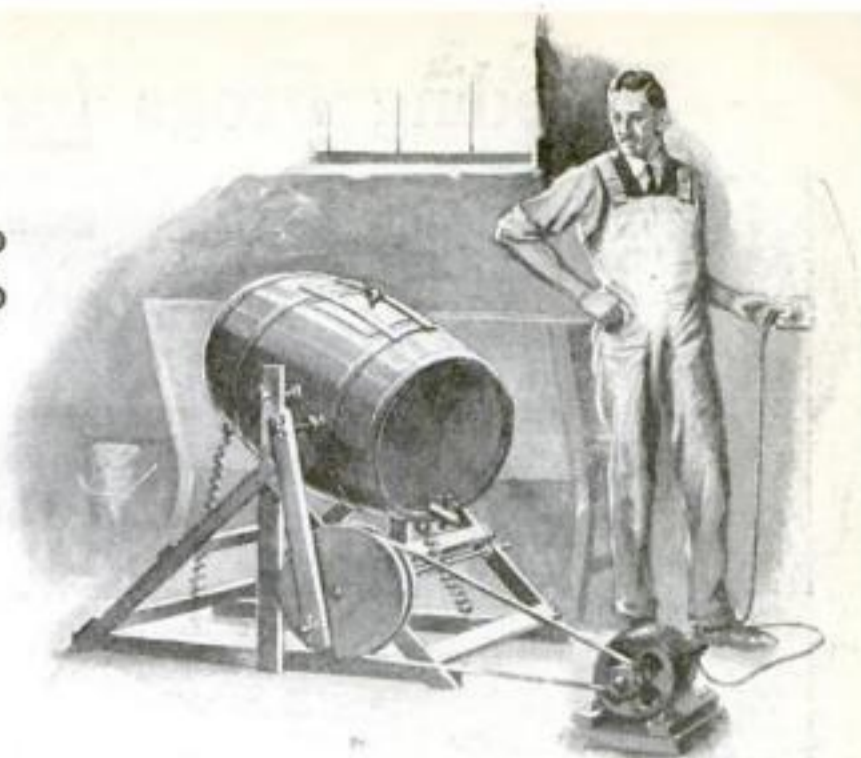
How an old bread-toaster was changed into a shin-roaster with the aid of an old dishpan. Grant U. Marcy is the originator of this idea. From the highly polished inner surface a pleasant warmth is reflected.



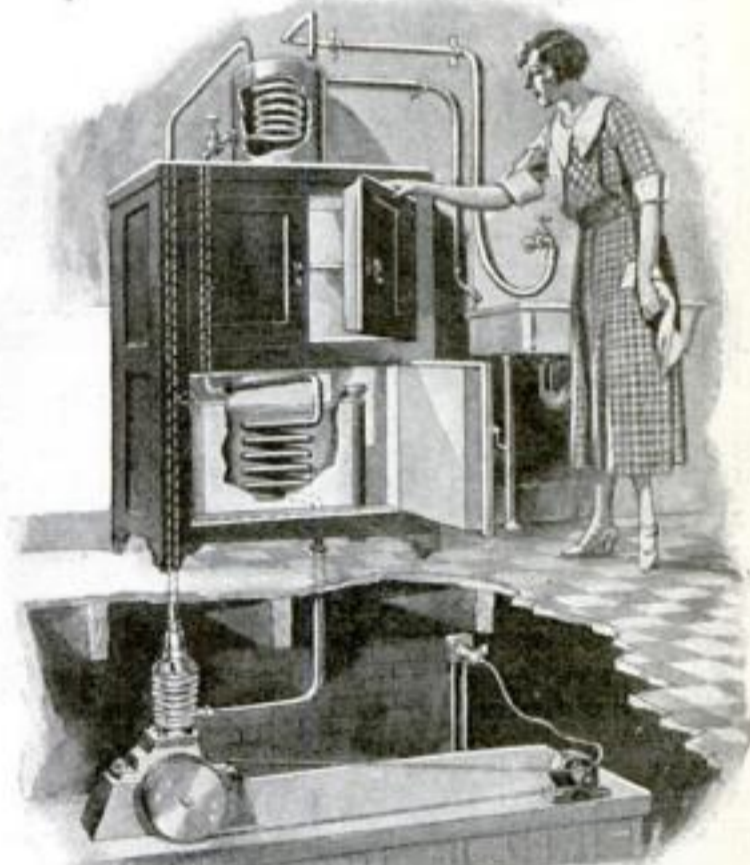
There is more than one use for an old hot-water boiler. Here is one of them. Gilbert M. Anderson, has found that an old boiler makes a splendid vermin-proof storage-bin for chicken feed and grain.



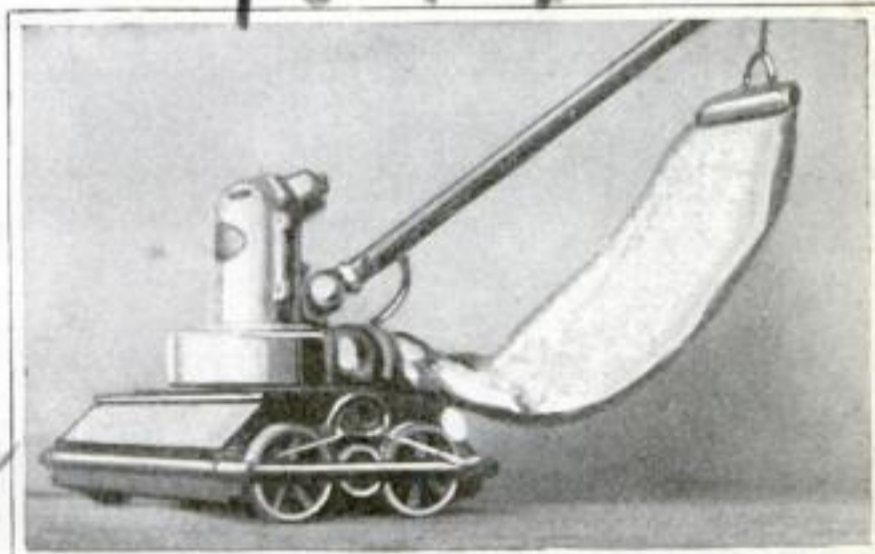
When the family alarm-clock "goes dead," the junk-pile usually receives it. Alphonse Hering spent a few hours in his attic shop and changed a useless alarm-clock into a reliable electric clock.



A washing-machine for three dollars! It was made from an old wine-barrel. William E. Beazley, winner of the third prize, provided his wife with a washing-machine that would do the work of one costing fifty times its price. (See Home Workshop for description)

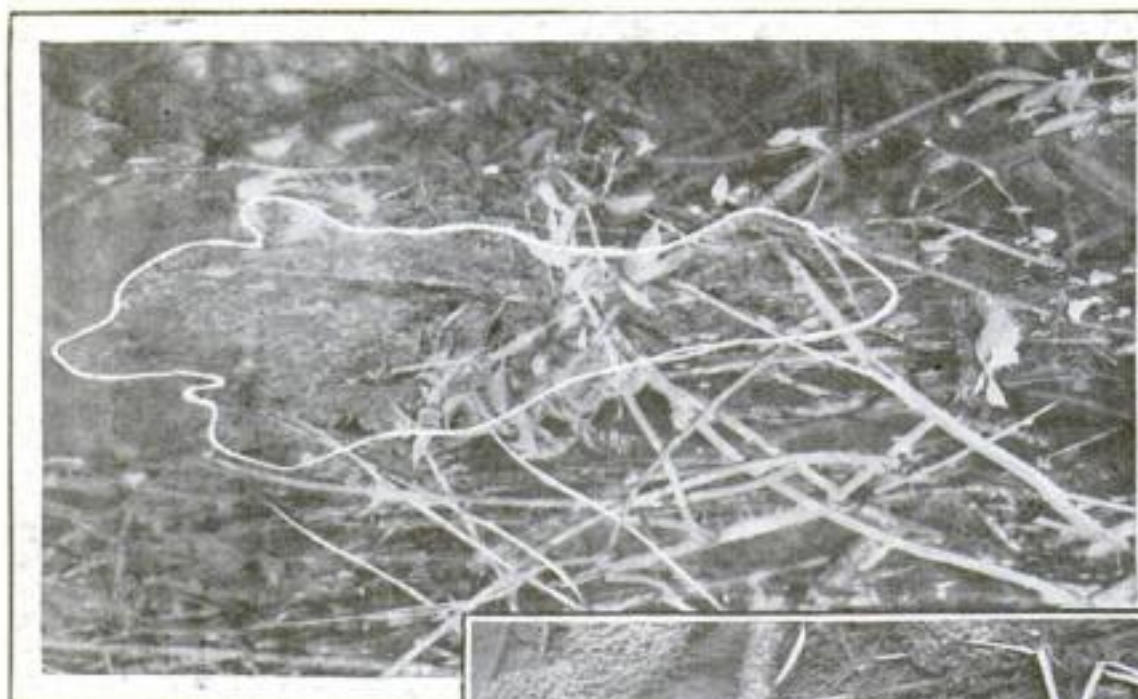


With an unused gas-engine that cost him a dollar, an old wash-boiler and some copper tubing W. N. Potts made a small refrigerating plant and won the first prize for his skill and ingenuity. (See description in the Home Workshop)



An old vacuum cleaner and an ancient carpet-sweeper combined into a useful cleaning device was the means of saving H. J. Brown sixty dollars—the price of a new cleaner.

Breeding Frogs for Their Legs at a Profit



When you breed bullfrogs, it is important to select the right species. While a dozen toads will bring five cents in the market, the same number of bullfrogs like the big fellow shown below is worth four dollars. Here are three photographs showing the relative sizes of eggs of the most desirable species



At the left are shown leopard frogs' eggs; above, the eggs of the green frog



THE demand for frogs' legs has led to many attempts to establish frog farms. Few of them have been successful and the reason has been ignorance of frog life. Mr. A. H. Wright, of Cornell University, has prepared a treatise on this subject for the United States Bureau of Fisheries.

He tells us, first, of the various kinds of frogs whose legs are most to be desired. There is the green frog, which has two prominent ridges down the back; the top of its body is bright green and the lower part is brown. The bullfrog is also a profitable species to

cultivate. It is larger than the green frog and has no back ridges. There is also the leopard frog, which is easily distinguished by the whitish color of the under part of its body. The pickerel frog is recognized by the orange-yellow color of its legs and abdomen. These frogs should be captured in pairs, if possible, during the months of April and May. They lay their eggs in ponds and at the bottom of small pools.

At present about a million frogs are caught in the United States each year for commercial purposes. Their



This is the most desirable kind of bullfrog to raise

market value is about fifty thousand dollars. Large frogs, like those mentioned above, will sell for three or four dollars a dozen.

Saving His Eye with a Telephone Receiver

A "LONE ranger" was sharpening an ax on an emery-wheel at his lookout station high up in the Rocky Mountains.

Suddenly his hand flew to his eye—a piece of steel had lodged in it! He tried to remove it with a handkerchief, but it had gone straight in and would not budge. He was twelve miles from the nearest doctor.

At that moment the telephone rang. When the ranger had finished speaking, the cap on the receiver dropped off. An idea!

He removed the diaphragm, exposing the elec-



He placed a needle against the electromagnet core in his telephone receiver, turned the crank until core and needle became magnetized, and the needle pulled out the steel

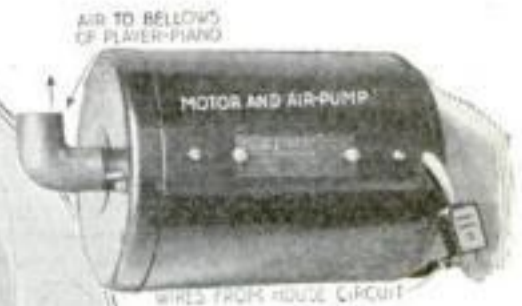
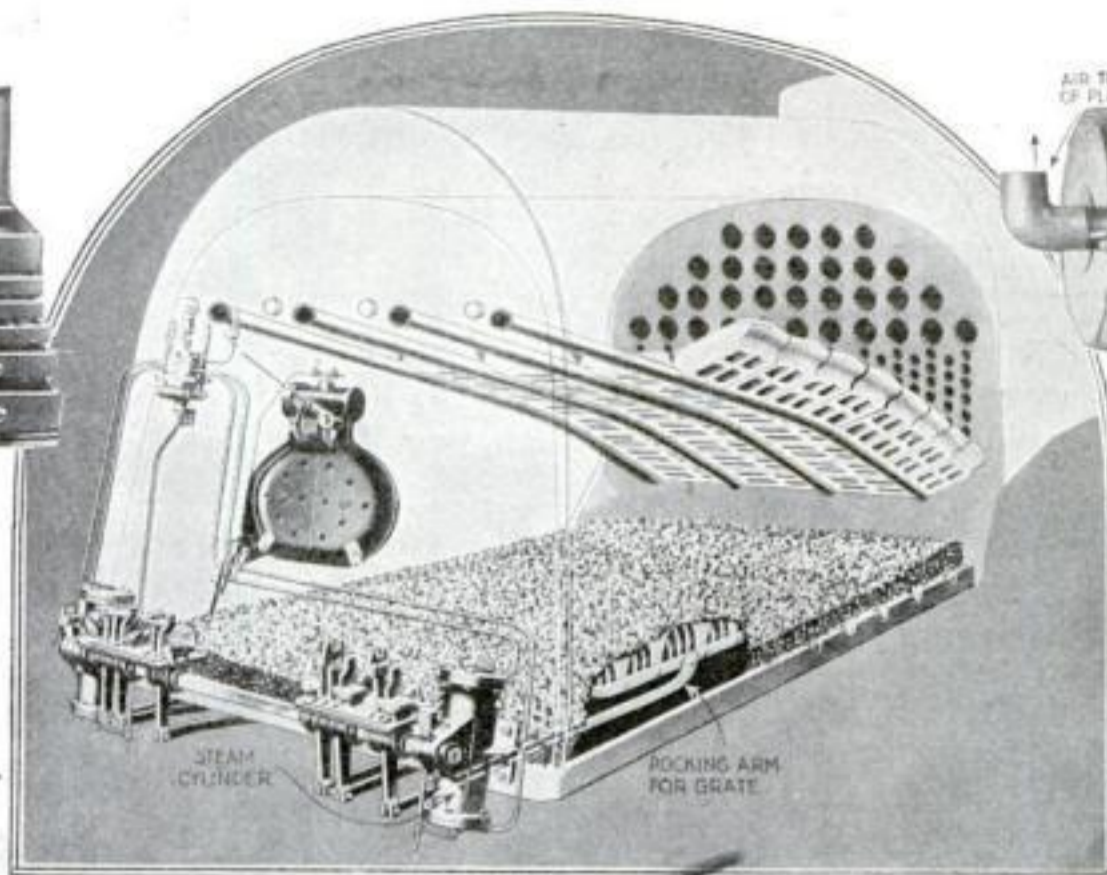
tromagnet below. Taking a needle in his hand he held it against the iron core of the electromagnet, while with the other hand he turned the generating crank, thereby sending electricity into the wires surrounding the core. The core became magnetized, and so did the needle which he held against it. The rest was simple.

He held the needle to his eye, and it promptly drew out the piece of steel, just as a horseshoe magnet will draw up tacks, which is but one more example of a man's making use of what lies at his hand.

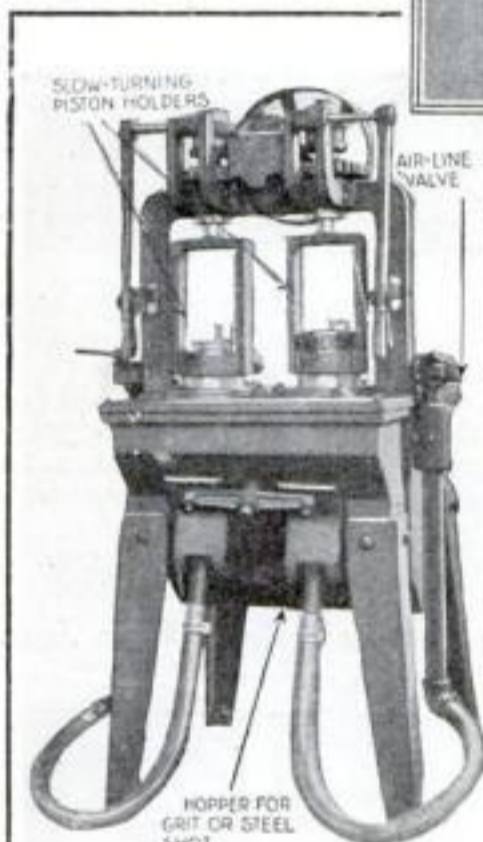
New Ways of Doing the Job Better



Here's a portable tool-chest to delight the heart of the careful user of tools, professional or amateur. It's of stout steel, weather-proof construction, conveniently divided into compartments.

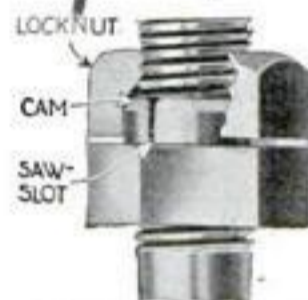


The installation of this power plant in the player-piano takes the last human touch from the household instrument. You can dance to automatic music at home or with pedaling eliminated, devote full attention to "expression".



By the use of steel grit or shot driven up from below this machine will clean the inside surfaces of from 140 to 150 pistons an hour.

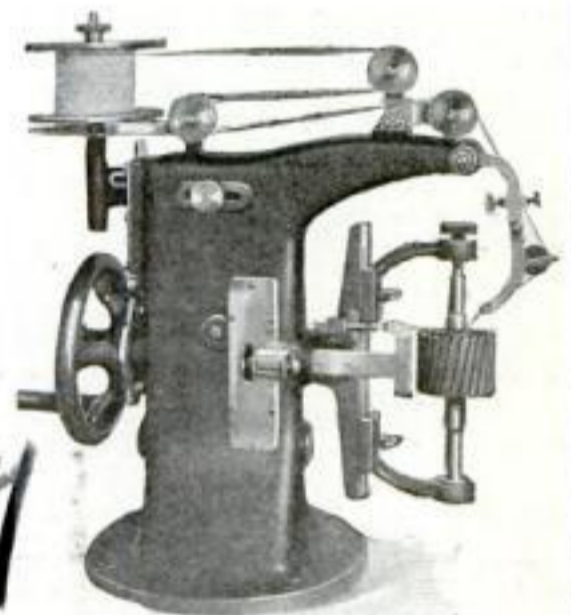
The locomotive fireman is saved a lot of hard work and the time required to clean the grates at the terminal is greatly reduced by this steam-operated grate-shaker.



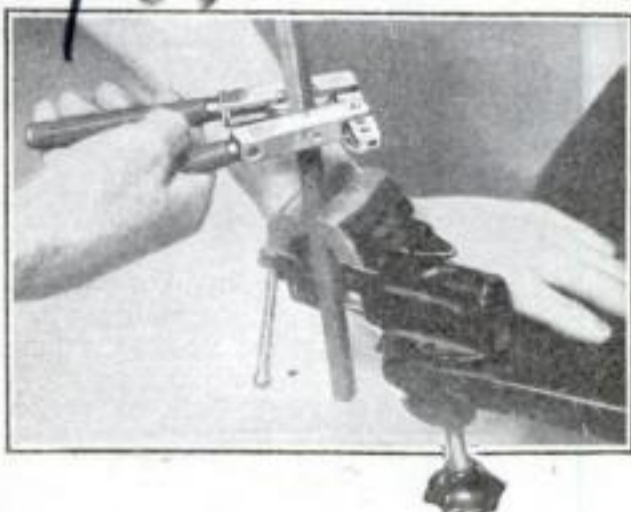
When the nut on this bolt is screwed down, it locks itself fast. The locknut acts like a vise and makes the cam hug the bolt.



A detachable ash-receiver for the automobile that keeps dirt, ashes from blowing about the car and into the faces of passengers.



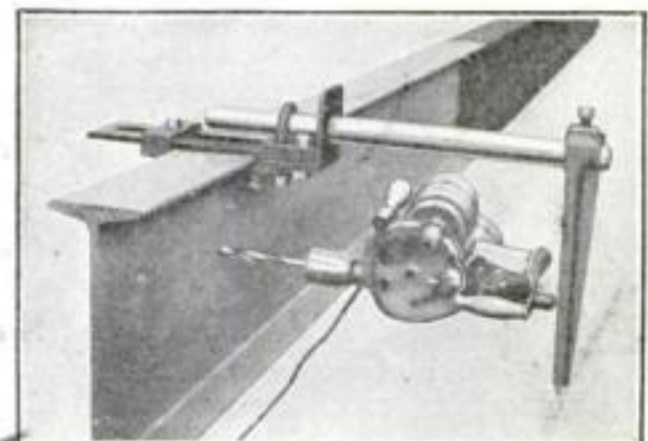
"Four men's work at the cost of one," is the performance claimed for this machine to wind light armatures up to one horsepower without removing the commutator. It may be operated by hand or power and it makes and twists the leads, counts the turns, and maintains uniform tension.



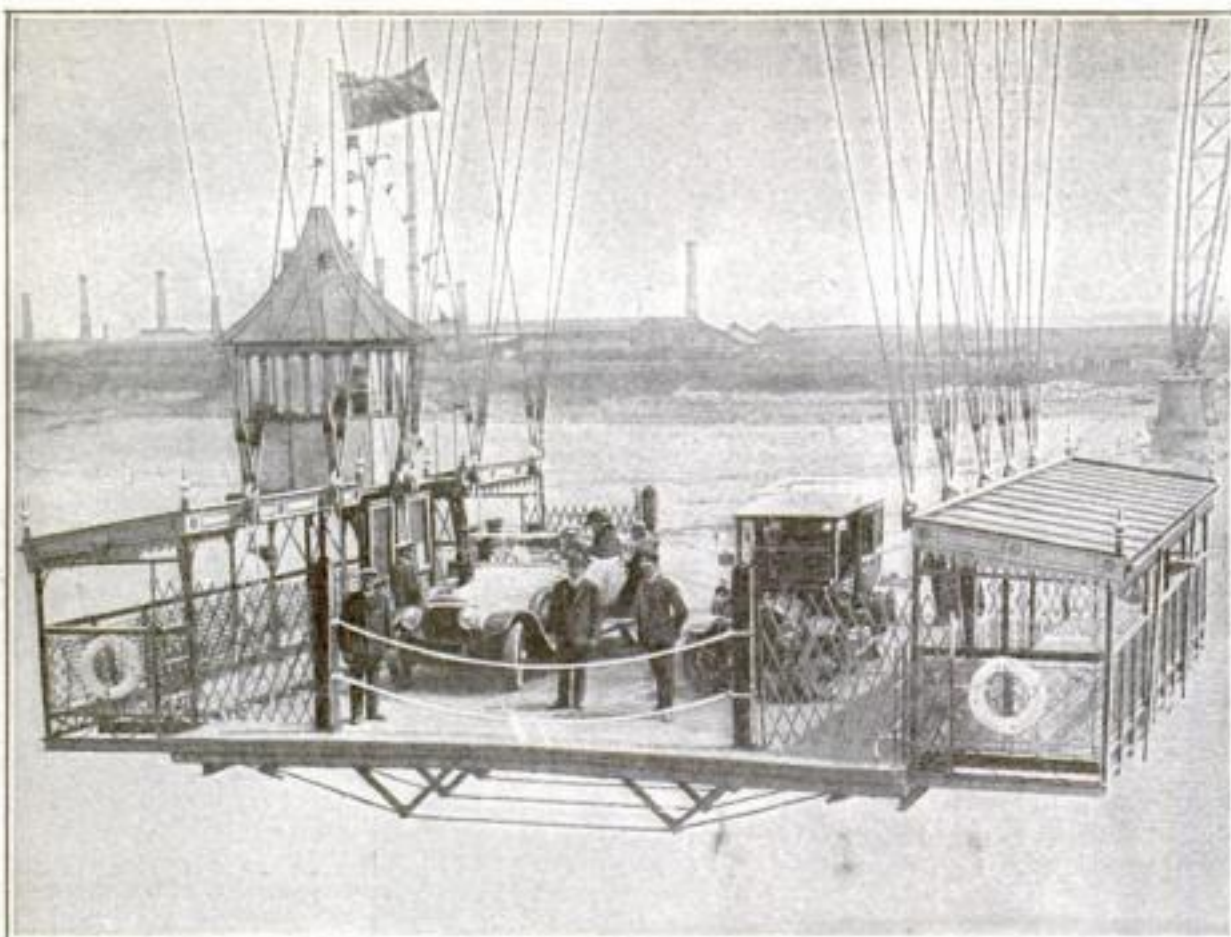
Hexagon and square stock cannot be knurled in a lathe, but this simple hand-knurler will do the work. It can also be used as a lathe tool if the stock is round.



A tool-grinder that follows the sun. As the light changes, the globular casing can be swiveled around, enabling the workman always to see clearly what he is doing.



This drill clamp and support were invented to do away with a drilling attachment called "the old man." Not only does it do the work better and easier, but it accomplishes sixteen times as much.



Welsh Aerial Ferry Carries Prince Across River

WHEN the Prince of Wales went from Cardiff to Newport, in his tour of his principality this year, he took the aerial ferry, one of the largest in the world. The platform is strong enough to carry five automobiles. The car is suspended from two cables to reduce swaying as much as possible.

The aerial ferry was installed because the river at this point is too shallow and swift to permit the use of boats at all seasons of the year, and it has been found that the people enjoy the novelty, that it is perfectly safe in operation, and that it makes more trips an hour than would be possible with water-borne vehicles.

Tower for Traffic Police

A TRAFFIC tower somewhat similar to the towers used by railroads has been invented by John W. Curry, of Cincinnati. An arm reaching out from the side of the tower carries four metal flags of the "Stop"



The traffic officer in this tower is able to view the whole field of operations

and "Go" variety. These flags are swung into position by means of levers inside the tower.

The tower itself is mounted on a pole. A ladder reaches from the ground by means of which the operator climbs in and out.



Experimenting with a Monkey's Fingerprints

BERTILLON'S system of measurements and fingerprint testimony combined will put a man in jail if they happen to agree, even with very little other evidence.

Fingerprints are considered of special importance because no two persons' fingerprints are alike, whereas many persons may agree in other measurements.

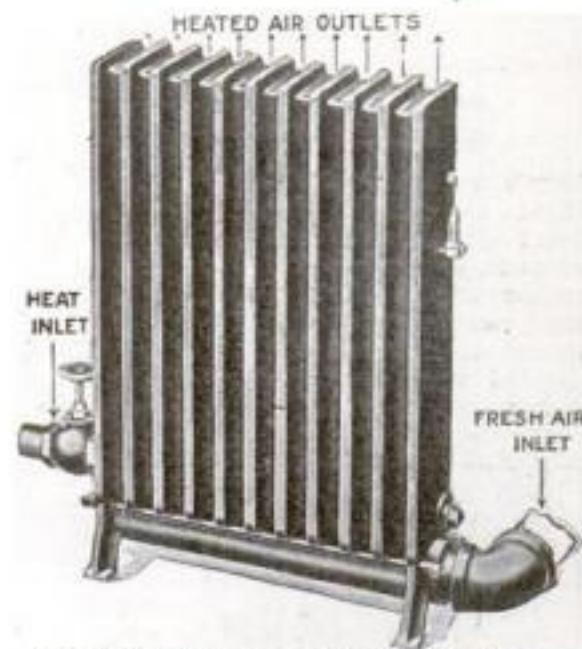
The Washington Bureau of Identification is making exhaustive experiments with fingerprints, among them being the comparison of a monkey's fingerprints with a human being's, and it is to this end that the serious old monkey in the picture is having his hand held by one of the detectives of the Bureau.

Playwrights and writers have used this method of identification as a basis for plots wherein the innocent suffered for the guilty, because the clever villain knew how to forge fingerprints on rubber and just covered the whole landscape with those of his victim.

It Ventilates as It Heats

WILLIAM R. HILDEBRAND, of Chicago, has just completed a new ventilating radiator which produces a constant circulation of warmed, moistened air. Connected with the outside, this new radiator sucks in fresh air, heats it to an agreeable temperature and distributes it freely throughout the room, thus affording ventilation without drafts.

The radiator is made with an air inlet running parallel with the heat inlet and



The air is heated and moistened by the steam as it passes through the radiator sections

these two conduits carry and distribute heat and air. The radiator gets into action as soon as the steam is turned on; a touch of heat will start the air circulating through the alternate air sections. Needless to say, the action is entirely automatic and the air suction, air blowing, or air circulation is brought about by the "stack effect" of the heated air in the radiator.

New Instrument May Give Jazz Fresh Lease on Life



When played, this instrument sounds like guitar, zither, and piano and is pleasing to the ear

THE discovery of possibilities for terpsichorean titillation previously undreamed of in the familiar slide trombone and saxophone started the world on a craze for jazz music, but the blues are becoming old fashioned and dance orchestras are looking about for a new instrument to captivate the dancers' laded ears. Maybe this is it. It is called the Astophon, and is said to give out music in a tone no man ever heard before, and yet to be musically pleasing.

It is played like a piano, but with fewer keys, and sounds like a combination of the guitar, zither, and piano, which gives the solitary musician an opportunity to rival a three-piece orchestra.

How the Chinese Spin Cotton

LABOR is so plentiful in China that the market for modern machinery is still small.

The picture shows the methods of cotton spinning used in the country districts. They have been in service without any improvement for many thousands of years.

A more primitive method of reeling the thread on the bobbins for use in the loom could hardly be conceived, but slow as it is, there are so many of these little plants and so many workmen that China turns out a very respectable quantity of well-woven cotton goods.



© Keystone View Company

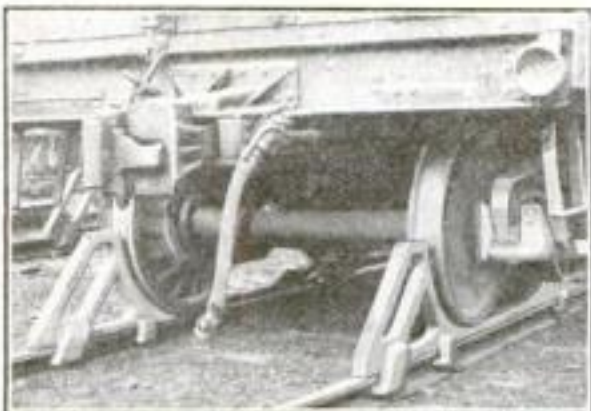
China has reeled cotton thread in this way for centuries, scorning all labor-saving machinery

Stopping Freight-Cars without Jar or Damage

BUMPING-POSTS at the end of yards, tracks, and factory sidings will stop a moving freight-car, but the bump is liable to be disastrous to fragile freight and the post cannot be moved to where it is wanted.

The sliding stop shown in the accompanying view will halt without the slightest shock a loaded car moving eight miles an hour. When the car engages the top, its speed is checked by the inclined plane which carries the wheels into shoes, and when wheels are in position the whole device acts as a brake as it slides along the track.

When the car is pulled off the stop, the front projection causes it to move with the car until the stop strikes a splice-bar. Then the wheels ride over the projection.



A sliding stop that will halt cars as effectively as a bumper, but without damage to the freight



The Broom that Will Never Wear Out

NEW brooms sweep clean, but for one reason or another most of the world's sweeping is done with worn brooms which leave part of the dirt on the floor, to the housewife's dismay.

The invention shown here allows the housewife to have a new broom as often as she wishes without the expense of buying one. It is a broom which can be refilled as fast as the broomcorn wears out. Unless the handle is used for a crowbar it should last a lifetime.

The refills come in four sections which lock into an aluminum holder. Pressing on the name-plate with the thumbs releases the old straw, fresh sections are inserted, and in ten seconds you have a new broom ready for work.

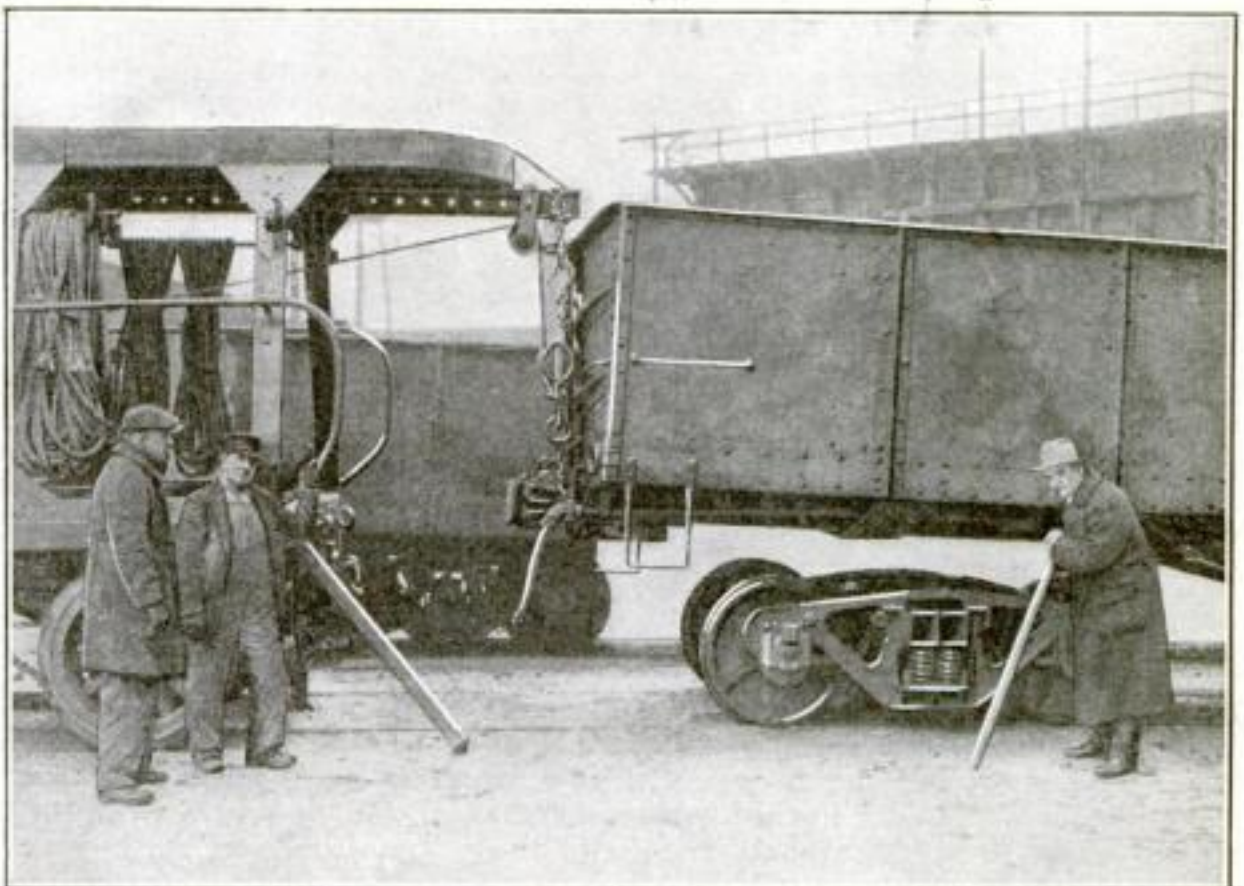
He Beats a Whole Rug at Once



© Kadel & Herbert

"Doc" Pierce, who has beaten carpets in Greenwich Village, New York, for forty years and more

IT takes a powerful man to swing this gigantic carpet-beater, but one of the inhabitants of Greenwich Village, who has beaten carpets for over forty years, claims that it allows one man to do the work of three. The beater is of tempered spring steel.



There's Power in This Big Wrecking-Truck

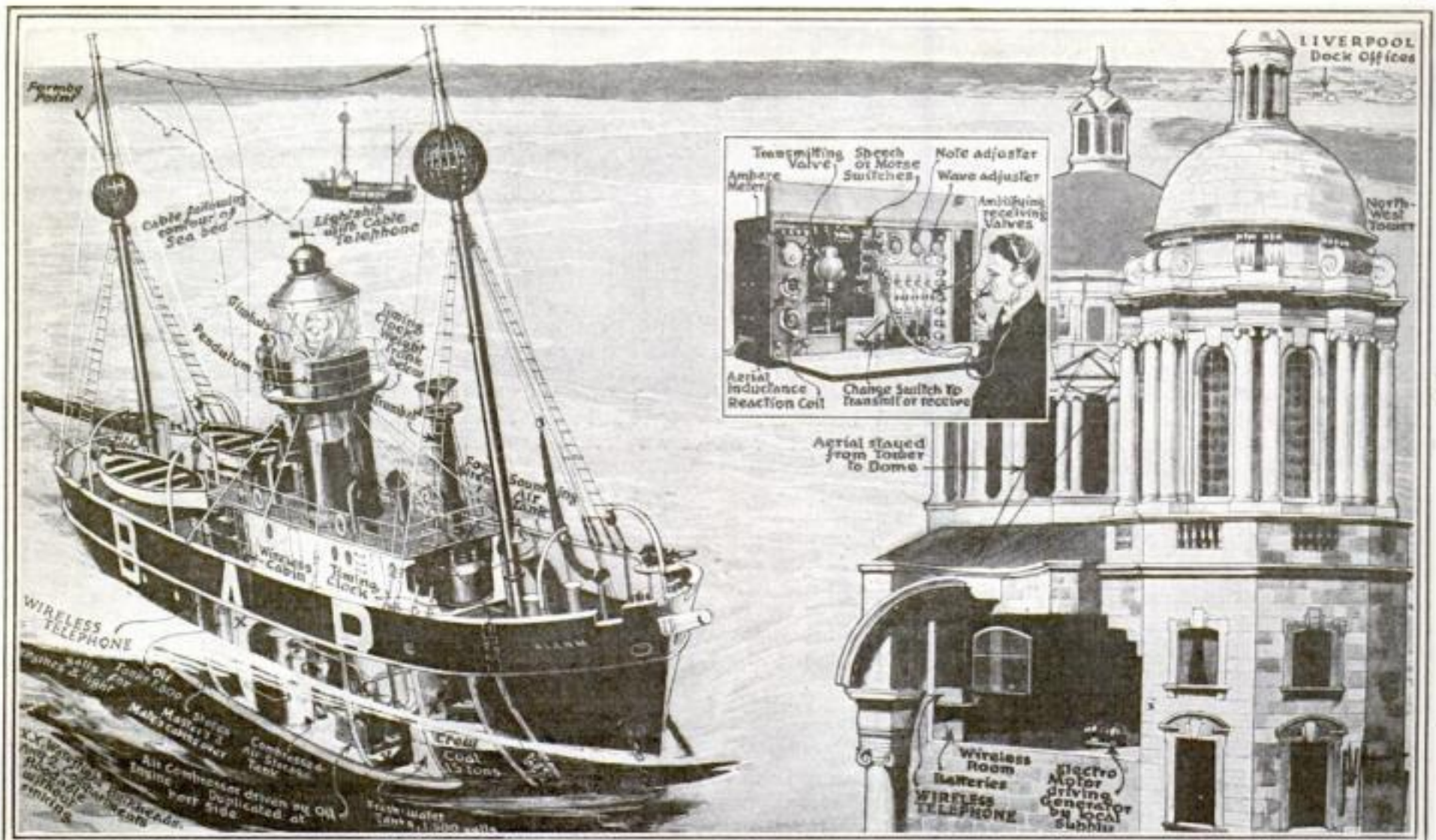
A PARTICULARLY heavy wrecking outfit for handling uncommon accidents is used by the city of Detroit. The ease with which it will lift a freight car gives an idea of its capacity. The truck has been constructed to utilize the full power of the engine.

The platform of the truck is constructed of six-inch steel "I" beams covered with a steel-plate floor and securely riveted to the chassis. A framework of six-inch steel channels is built on this platform and the channels are heavily braced and tied together with riveted gusset plates. Number 10 gage steel plates form the roof. A six-

inch steel trolley beam is secured to the under side of the roof beams.

To the free end of a three-quarter-inch steel cable passing over the heavy cable sheave on the trolley is attached a slip-hook, and the other end of the cable is attached to a heavy-duty horizontal power drum-winch securely bolted to floor beams. A power take-off and sprocket chain-drive connect the drum-winch to the truck engine.

One man can operate the winch brake and power control. Large and roomy tool-boxes built in below the platform on each side of the truck contain a full tool equipment.



© Modern Publishing Company

Drawing by S. W. Clatworthy

Lonely Lightship Crews Have Wireless Telephone to Land

THERE is no more solitary and lonesome occupation than that of the crew of lightships. Miles away from land, often out of sight of it, there is nothing to while away the spare hours. Only when kindly ships pass near enough to toss aboard bundles of the latest newspapers do the members of the crew learn what is going on throughout the world.

But this condition bids fair to be changed by the wireless telephone. The B.A.R. lightship at the entrance to the Mersey, near Liverpool, England, is the first one to be so equipped, and while the installation was made principally for life-saving purposes,

it is easy to imagine that the men forced to live on the anchored beacon ship will use it for social purposes.

The set itself is what is known as the Marconi YBI set and is portable. Its speed of communication is said to be ten times faster than the wireless telegraph, and moreover it does not require skilled operators. Because of this the ship and government officials will be able to converse direct without intermediaries, as is necessary with the telegraph.

The storage batteries for the wireless telephone are kept charged by the oil engine used for driving the air compressor on the foghorn.

A Phonograph Makes Her Sing and Talk

HERE is a new type of talking doll that can speak or sing in any language that is "phonographically" recorded for her. Indeed, if given a brass band record or a violin solo, she will do it as well as she will recite a poem or say the alphabet.

The miniature record on non-breakable celluloid compound is in the form of a cylinder, inserted around the miniature motor in the side of the doll's body. The pressure of a lever starts the mechanism.

A compact cylindrical spring motor revolves the record. This reproduces the sound. When the end is reached, an automatic device throws the record back into position.

A decidedly new feature is the motor itself, invented by William Rotter, of New York. The usual phonograph motor is "governed" or regulated, so that its rate of motion will be even, by means of flexible steel bands on which small weights are placed. The new motor has a circular governor that regu-

lates its speed without the old-style weights and spring-bands. It runs at the low rate of two hundred revolutions a minute. Not only for dolls is the new phonograph suitable. It is also applied to a toy telephone in which the bell rings while the motor is winding. When the receiver is taken down, the phonograph starts, and music flows from the mouthpiece.



The phonograph record is inserted in the doll's side, where it slips over the mechanism that revolves it

Poison Set for Squirrels Starts Forest Fires

SQUIRRELS have been so troublesome in the northwestern part of the United States this year that bait soaked in a phosphorous compound has been spread broadcast to rid the land of the pests. But the settlers are wondering if the move was wise. Squirrels are more desirable than forest fires and the poison has been found to be responsible for many of the latter.

A timber cruiser noticed that the friction between his hobnailed boots and oats soaked in the poison created sparks and started a blaze.

When this instance was reported to the authorities, an investigation revealed the fact that several other lots of the poison had been ignited by heat from the sun, but had been extinguished before much damage had been done.

Since this discovery, fire patrols have been ordered to watch carefully all land where the squirrel poison was distributed.

Life-boats Launched from Ships with Heavy List

MARITIME annals are replete with instances where life-boats have ridden out a storm in safety after the ship had foundered. The moment of danger in a storm or a collision at sea is the instant the boats are being put over the side of the ship. The liner may have a dangerous list that makes it impossible to launch the boats on one side at all; boat-falls will jam; the seamen unhooking the tackles after the boat is water-borne may lose his head and swamp the boat in getting away from the side. The emergency calls for cool heads and launching apparatus that is fool proof, simple, and automatic in action.

The recent International Conference on Safety of Life at Sea recommends that liners carry boats for all; but on large ships this is hardly practical, as there is not sufficient storage space about the decks. Still, the conference decided that there must be boats for 75 per cent of the personnel, and the pontoon rafts for the remainder must have canvas bulwarks to protect their occupants from exposure.

These new davits can still be used to launch life-boats even when the ship is listed 10 degrees

The crux of the life-saving problem at sea is the launching-gear, and the cranes depicted possess three great advantages. First, they swing the boat far enough from the ship to permit launching with a list of 10 degrees. Second, they may be operated by two

men, instead of a crew of ten or twelve needed for the old davit systems, and the use of wire falls reduces the danger of breakage in emergency and the expenses of upkeep.

Third, and very important, the cranes permit rapid launching.

It is claimed by the makers that a liner carrying a hundred boats and equipped with forty cranes can launch fifty-three hundred people in half an hour under any conditions of wind, sea, or list. Using one crane for nests of four boats reduces the weight of the launching-gear from forty to fifty per cent.

POTASH for fertilizer and explosives can now be produced from American raw materials. By treating greensand with lime and water under high temperature and pressure, free caustic potash is produced, and a valuable residue recovered that can be used in the manufacture of brick.

There are vast beds of greensand extending from Massachusetts to New Jersey.

Signal Warns of Prisoner's Escape

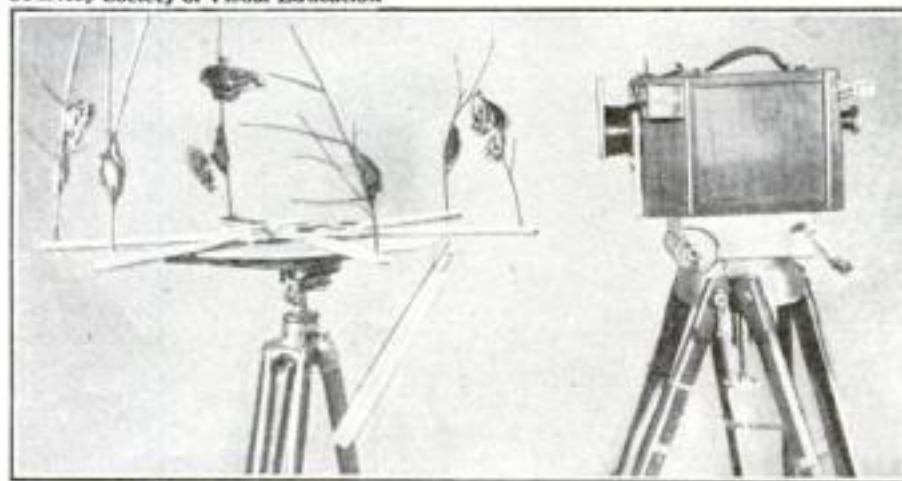
WHEN *Samia cecropia* pried aside the bars of the cage that had held him prisoner for many a long week, he was not aware that his escape had been signaled to the authorities in time to have a movie photographer on the spot. But his actions were known long before he emerged, and as a result, his story will soon be known to all the school-children in the country. For although *Samia* had been a prisoner, it was not his fault. *Samia* was only a silkworm, and the jail was his warm cocoon. That is, he was a silkworm until shortly before he came forth as a brilliantly colored butterfly with the "thumb mark of the Maker" on his wing.

It had been found extremely difficult to record the escape of the *Samia cecropias*. They give no warning when they tire of their cocoon. They simply eject a fluid that softens the fibers making up the walls of their cage and then are able to pry the strands aside and come out. All this re-

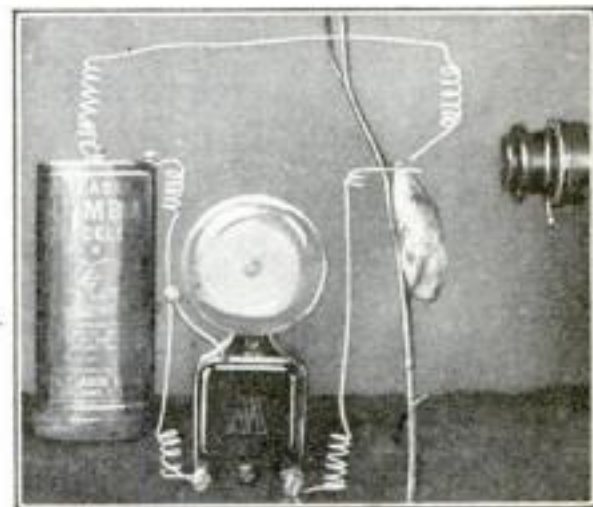
quires but a few minutes, so it was up to the company taking the motion-pictures to arrange some signal to notify the cameraman when the beautiful prisoner had decided to move.

This was accomplished by the device shown in the illustration. The ends of a battery circuit in which a common doorbell was placed were so arranged that the slightest motion of the end of the cocoon would bring them together, complete the circuit, and ring the bell. By hustling, the camera-man was then

Courtesy Society of Visual Education



By placing the cocoons on a swiveling tripod, the *cecropia* that shows signs of emerging may be swung instantly in front of the camera



The simple electrical arrangement that signals the cameraman when the silkworm commences to escape

able to light up the powerful lamps and commence to crank his camera. A few minutes later the show was over, but the film will always remain as an exact record of the *cecropia's* method of escape. School-children can learn more from a short film of this nature than from thousands of words in textbooks.

Latest Railroad Transfer Tables Need No Deep Pits

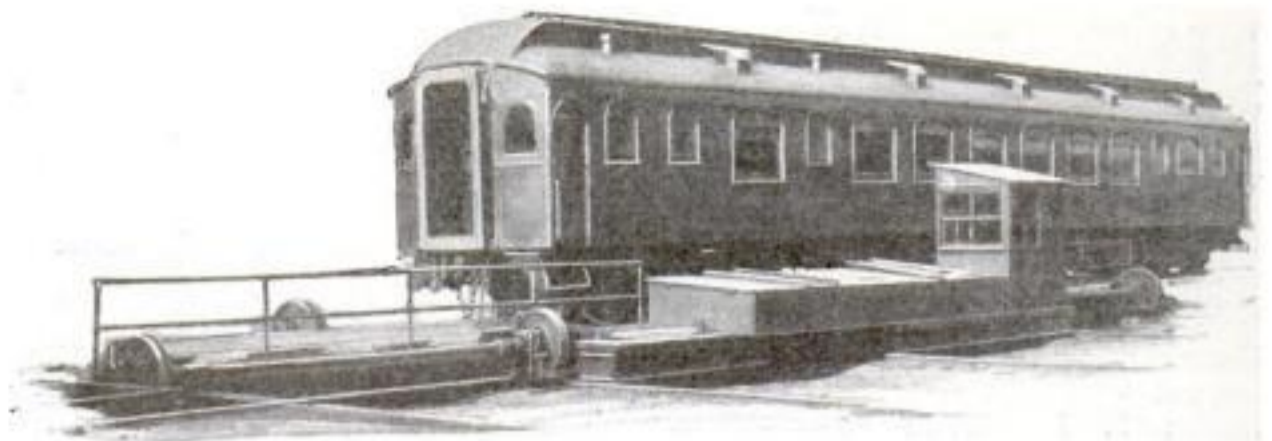


© Kadel & Herbert

To Make the Feet Work for the Armless

AN ingenious invention exhibited in London for use by disabled veterans enables an armless man to shave, wash, eat, and even light a cigarette by the action of movable levers worked by the feet. It is designed as part of the equipment for hospitals of vocational rehabilitation, where it is employed to convince mutilated men that even the loss of both arms need not make them entirely dependent upon others.

The foot pedals control the movements of the upper end of the levers accurately in three planes, but in shaving it is best to attach a safety razor to the machine—although the inventor claims that after a little practice the old style straight-edge can be used without too great a risk.



Like a traveling crane with its load on top

TRANSFER tables are used in railway shops and car-works for carrying locomotives or coaches rapidly from one track to another. The latest type follows the principles of traveling-crane construction. It is virtually a traveling crane that carries its load on top and moves along the ground instead of in the air.

The feature of the machine illustrated is the shallowness of the pit. A shallow pit

means less expense for excavation, and this one is only eighteen inches deep. The transfer table is moved by an electric motor, driving wheels by one continuous axle, and follows the "safety first" practice of modern railroading by having sufficient clearance between the table and the pit-wall for a man to stand without injury, even when the table has traveled as far forward as it can go.

"Marketgrams" Sent Broadcast by Government Radio

WASHINGTON'S new radio station of the Post-Office Department will be used in coöperation with the Department of Agriculture to distribute market reports to farmers. In connection with the fifteen minor radio stations of the Air Mail Service and the six thousand licensed amateur stations, farmers throughout the country can keep in touch with current prices of their products at the city markets. The principal purpose of this radio station will be to communicate with mail-planes while in flight.

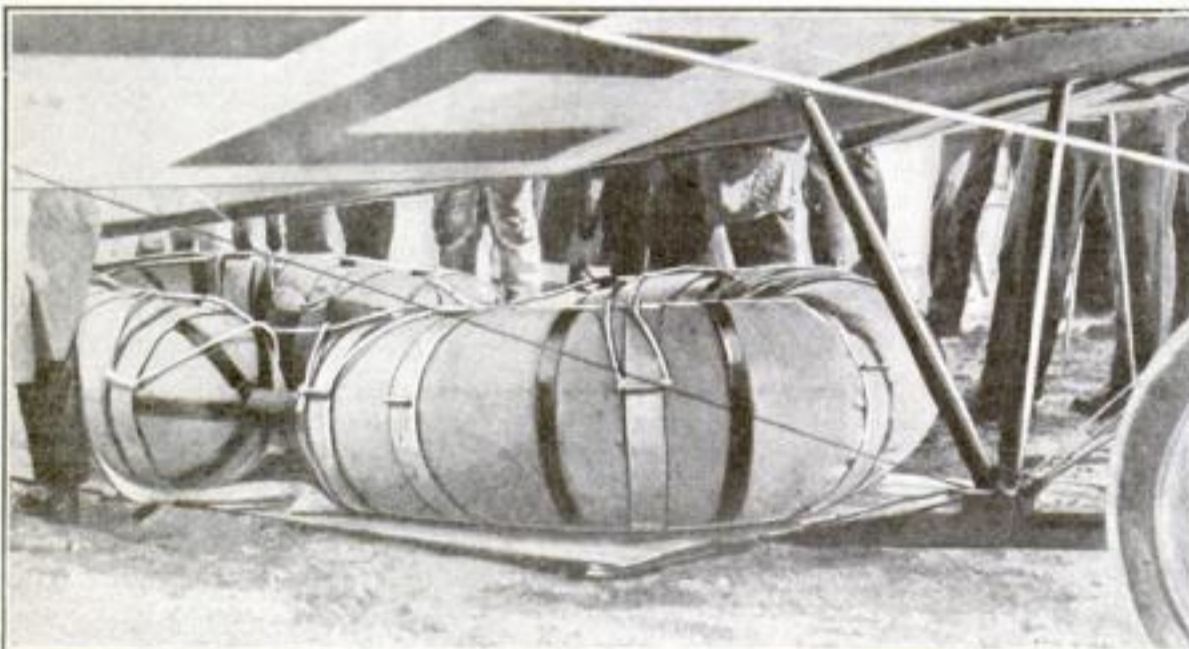


New Surfacing Machine Saves Space in Shop

DEPICTED above is a general utility surfacing machine that occupies very little space, although it carries a 63 by 4 inch high-speed abrasive belt. The arms supporting the abrasive-belt pulleys can be swung about the center of the driving-shaft and clamped securely in any position necessary to the performance of surfacing operations. Thus the belt surface may be located in a horizontal or vertical position, or at any intermediate angle.

It is possible to drive the machine from a countershaft, a separate motor, or by a direct connection with the end of the shaft. The machine can easily be attached to a table and moved around a shop from one job to another, wherever it may be needed.

Life-Raft for Landplane Makes Sea Flight Safe



The raft is collapsible and can be filled instantly with compressed air

THE accident in which two army flyers were drowned in a forced landing in Chesapeake Bay might have been avoided had their planes been equipped with this life-saving raft recommended by the British Air Ministry for landplanes whose pilots expect to fly over water.

The raft is a pneumatic affair with a

wooden platform on which the aviator can stand until rescued, should his machine sink. It is carried under the fuselage of the plane and can be released from the cockpit as the under carriage strikes the water; or it can be left attached and if there isn't a crash on "landing," it will keep the machine afloat.

EVERY one knows the Oldest Inhabitant who remarks that the weather now isn't as cold (or as hot) as it was when he was a boy. He is wrong. Records of the New Haven, Connecticut, Weather Bureau, kept since 1780, show the average mean temperature of winter has been constant for 140 years. The mean is about 49.5° F.

The coldest decade on record was the ten years ending in 1820, 47.5°; the warmest, the decade of 1920, 50.5°. The difference is only three degrees.

Why Do We Do These Stupid Things?

Why Do We Work with a Glaring Light Shining in Our Eyes?

WHEN we know that electric light is rich in actinic rays that hurt the retina? Ninety-eight per cent of eye troubles are the result of strain, which is often the consequence of glare from which the eye tries to defend itself by contracting the pupil. Even when the pupil is no larger than the head of a pin, the actinic rays are still too strong, and the effort to shut them out overstrains the delicate muscles of the iris.

Why Do We Live on a Meat Diet?

WHEN we know that meat, eggs, and fish are protein, of which the amount actually required in body repair is only about 2.4 ounces a day. If we eat more than we need, the body simply converts the excess protein into fuel. The whole process taxes the liver and kidneys and creates waste that poisons the system.

The body fuels that we should eat are fat, starch, and sugar. They are cheaper to buy and are readily absorbed. Meat should be no more than a tenth of our food. Its function is simply to replace worn body tissues. The coolie on his rice diet can do as much physical labor as the meat-fed American.

Why Do We Put Off the Hardest Work Until Late in the Day?

WHEN psychological tests show that a man's working efficiency rises from the time he wakes until about ten-thirty, then falls slightly until one-thirty; then rises a little—but never so high as in the morning—until about three; and after that drops rapidly.

The morning hours when nervous energy is greatest should be given over to the hardest and most important tasks.

Why Do We Go without Water All Day Except at Meals?

WHEN we know that a man, to keep healthy, must drink from six to eight glasses of water daily. Drinking at meals does something worse than "dilute the gastric juice." It makes us careless about the proper mastication of food. Instead of chewing it, we float it down. Eating too fast is injurious because if food is not emulsified by the teeth and thoroughly mixed with saliva, it cannot be completely digested.

If we don't drink too much water with our meals, it is impossible to eat too fast, since we then cannot swallow food until it is properly moistened with the ptyalin secretions.

Where Telephones Are Plentiful

THE city of Stockholm, Sweden, is said to be the best telephone-equipped city in the world. Of its four hundred thousand inhabitants, one hundred thousand are telephone subscribers.

Public telephone-booths can be found on every street, and should you go into a



Telephone booths on the streets of Stockholm

restaurant for a meal a telephone is handed you with the bill of fare. As soon as a ship enters port, it gets its telephone connection.

Shown above are two of the telephone booths that are a common sight along the streets of the Swedish capital.

Applying Twentieth Century Methods to Cheese-Making

THIS unpretentious little hydraulic press is expected to revolutionize the cheese-making industry in the United States.

At the present time the operation of compressing the cheese into the compact form with which buyers are familiar is performed by hand with lever presses and

© Harris & Ewing



Compresses cheese in twenty-four hours

heavy weights, and requires a large amount of space. K. E. Parks, dairy engineer of the Department of Agriculture, has invented a machine that compresses a cheese automatically in twenty-four hours. This is a great gain in time over the old process and the machine takes up only about ten square feet of floor space.

You can't burn out the temperature-controlling device used here



This Glue-Pot Doesn't Need a Water Bath

IN order to obtain the best results, glue should be applied at a temperature of 150° F. An automatic electric glue-pot has been perfected, after nearly four years' research, which maintains this constant temperature. In the earlier models, when the water was allowed to boil away, the heating unit would build up sufficiently to burn out the temperature-controlling device. To overcome this, the latter was placed in a core or channel of metal directly across the bottom of the pot. This model can be operated with or without water.

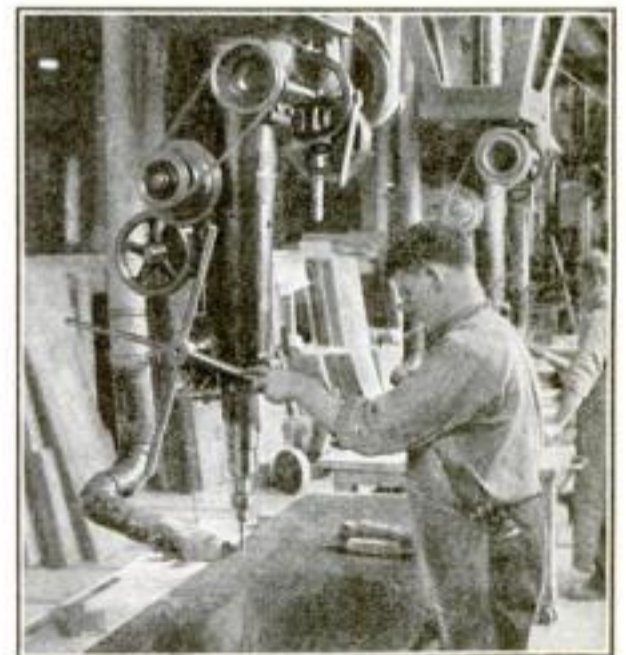
The temperature-governing device consists of a sensitive tube connected with a pressure-responsive mechanism upon which are mounted suitable electric contacts that may be adjusted for any temperature. These govern the current supplied to the heating coil.

AIRMEN of the British Isles are going to make systematized reports of the heights attained by the various species of birds.

Suspension Drill Handles Work of Any Size

BELOW is a suspension drill, invented thirty-five years ago. The inventor was in advance of his time, and it is only recently that mechanical processes have begun to require such an invention. The purpose of the device is to permit plates of metal or stone of any size to be passed under the machine without interference.

So long a time has elapsed that the manufacturers themselves are not sure who the inventor was, but when the need arose



Drilling insulator slabs

they put his invention on the market with only a few minor improvements. It is of the greatest value in any shop which is producing plate or flat work of unusual proportions. The operating mechanism resembles that found on the usual type of upright drilling machine, and the absence of the machine table permits the work to be held in any manner desired.

Telephone with Both Hands Free

SOME telephone companies will not permit attachments which are permanently connected to their instruments or which require alterations in the standard desk



This receiver can be adjusted to the convenience of the user, freeing the hands for taking notes

telephone, but this invention of E. A. Bensburg, of St. Louis, may be slipped on and off at pleasure.

The telephone fits snugly in a shallow, saucer-like depression in the base of the invention, to which is mounted a rod working in a ball-and-socket joint at each end, with a slotted holder to support the receiver. Both hands of the person using the telephone are thus left free to take notes or arrange memoranda. The invention may be adjusted to the height of the person using the telephone.

Shot Used to Test Lasting Power of Roads

INCREASING use of the heavy motor-truck for short hauling is breaking up roads that were built for lighter traffic and it is important for engineers and



Falling shot drives a bearing-rod into the road-bed which is to be tested for its hardness

municipalities to know exactly what load a road will bear and how long it will withstand the pounding it receives. In building

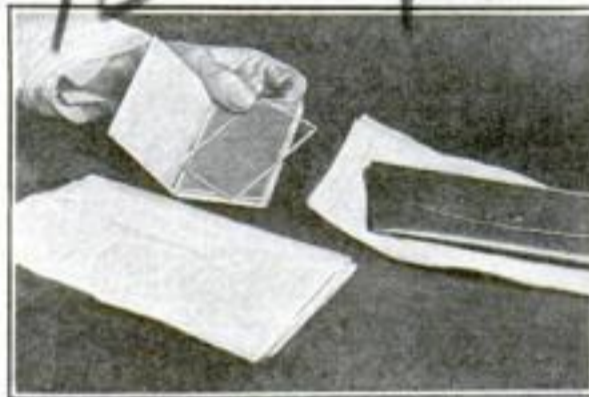
a new road, the hardness of the subsoil determines how deep a layer of broken stone or concrete will be needed to make the road last. In the past this has been largely a matter of guesswork.

The machine designed by the United States Bureau of Public Roads is adapted for field use in testing the bearing capacity of highways. The cylinder in the center of the tripod-shaped form is a receptacle containing shot, poured in from the funnel at the top of the instrument. The load of shot falls on the top of a bearing-rod, the point of which bores into the soil, and the dial beneath the funnel measures the penetration to the thousandth part of an inch.

Loads equivalent to two tons to the square foot may be applied, although the device weighs only seventy-eight pounds, and on the data thus obtained the engineer can base exact calculations for building a permanent road with the minimum outlay.

Soap and Towel in a Pocket-Book Please the Fastidious

THE leaves of this little book are made of soap and each one is enough for a thorough toilet. The towels are paper, of course, and the whole outfit, equipment



A "book" of soap and pocket towel add to comfort of traveling

for a week's trip, is small enough to go into a pocket-book or a wallet.

It has been invented for travelers who must go into countries where the linen of the hotels is not above suspicion, and for the fastidious who prefer to use their own materials no matter how clean the towels look.

Daylight Egg-Candler Aids Farmer and Shipper

FARMERS who produce a few eggs for sale and small shippers will be interested in the egg-candler invented by Professor F. E. Mussehl, of the University of Nebraska. No dark-room is needed with it. By the use of a triangular wooden screen and a reflector, which concentrates the light on the egg through a small aperture, the condition of the egg can be determined.

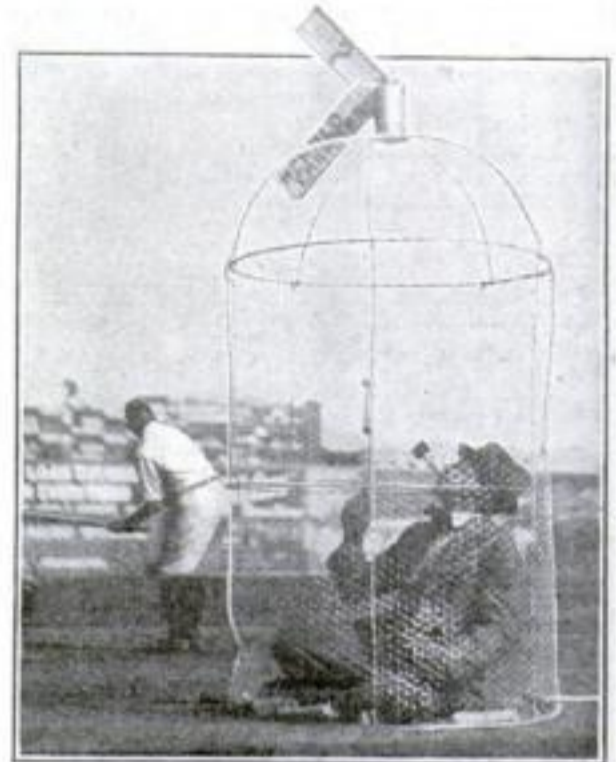


To candle eggs without a dark-room

The operator faces the light so as to secure the contrast between the light back of the candler and that which comes from the open. The egg is held with its large end against the opening, and, by giving the egg a brisk turn, the consistency and qual-

ity of the yolk and the white, as well as the size of the air cells, can be easily examined. The candler is effective in testing incubator eggs.

Safety First for the Umpire



Protected from pop-bottles, he doesn't worry whether his decisions please the spectators

EVERY big-league umpire has experienced moments in his life when he would have liked a contraption such as this hand-plug ear-plug to shut out pertinent but over-vigorous comments from fans. Using his cage while officiating in an exhibition game in Los Angeles, Carl Sawyer, motion-picture comedian, found that he didn't have to hot-foot it for refuge every time the pop-bottle crowd objected to a decision, announced by means of the semaphores at the top.

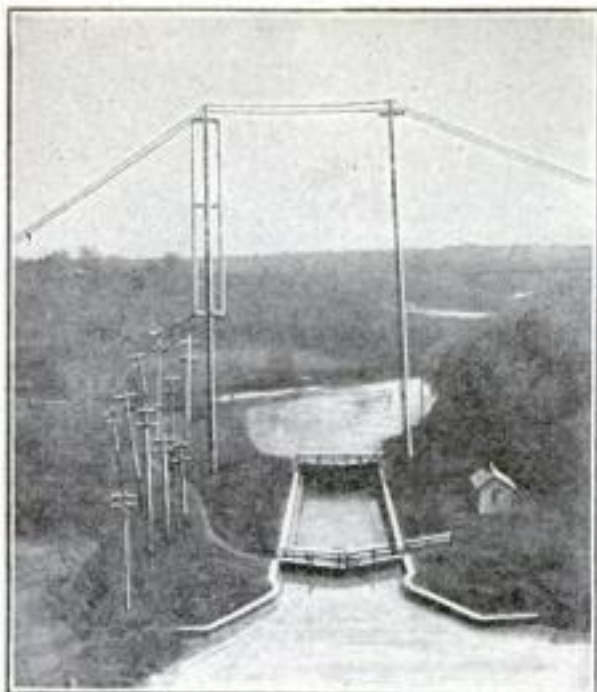
Well-Known Movie Actress Has a Portable Dressing-Room

To save time in changing costumes for the "movies," Elsie Ferguson has supplied herself with a portable dressing-room. It is in the form of a little house on wheels,



Time is saved by having this dressing-room moved around the "lot" as scenes are changed

which is pushed from one part of the "lot" to the other, and obviates building a dressing-room every time the scene is changed.



World's Highest Concrete Telegraph-Poles

DO you know that the world's highest telegraph-poles tower one hundred and fifty feet above the ground? There are two of that height located near St. Catharines, Canada, used to carry high-tension power lines over a canal, the great height being necessary to allow room for the masts of ships.

The fact that these poles are placed without any guy-wires or braces is even more remarkable than their height. Even a steel mast of this height is usually guyed and stayed, and a very elaborate system of steel-rod reinforcing within the concrete pole is necessary to allow this precaution to be dispensed with.

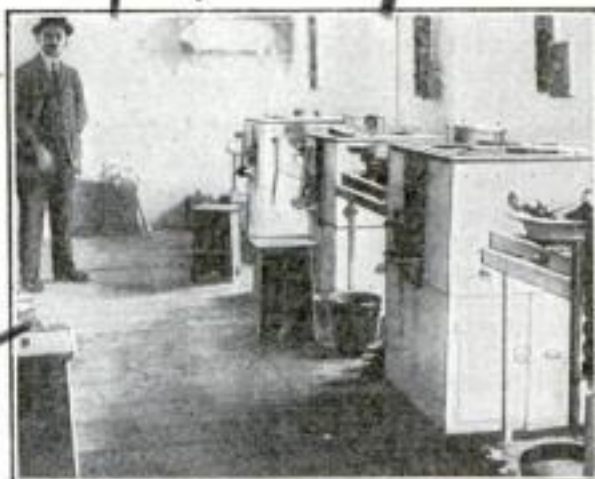
Listening to a Radio Concert Over a Kite-String

BY the historic experiment of Benjamin Franklin, we learned that a wet kite-string was a fairly good conductor of electricity. The same principle is put into practice by the canoe enthusiasts in the illustration, who are listening to a wireless-telephone concert.

The kite is flown on a wire thus offsetting the necessity of waiting for a rain-storm in order that the string may be a

This Russian Field Oven Conserves Fuel

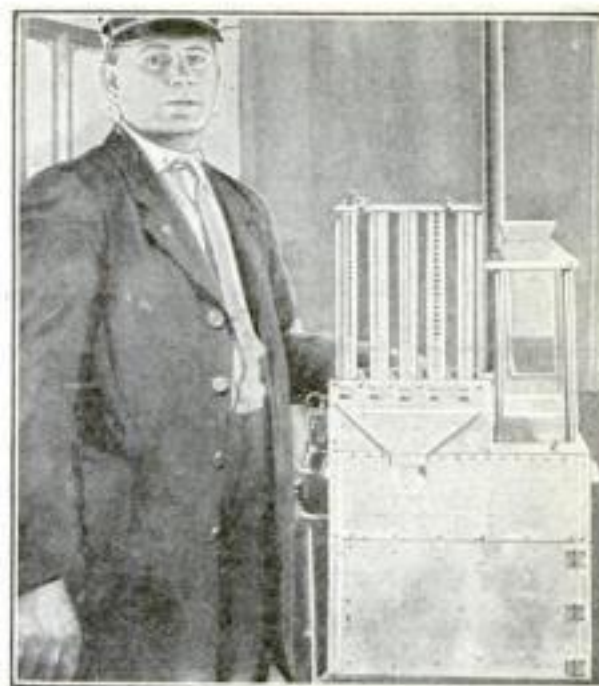
PROFESSOR BOGATYOW, a Russian inventor, now resident in Siberia, has perfected a remarkable field oven for military use which cooks large quantities of food rapidly with an extremely small amount of fuel. The oven is constructed of pressed steel, divided into four compartments so that several courses can be cooked at the same time. The great economy of fuel is secured by vacuum



Using six pounds of wood, this field oven will cook a meal for two hundred soldiers in an hour

compartments between the steel walls, so that the oven is essentially a huge fireless cooker with a stove in the center.

In a recent test at Belgrade, according to a report, one oven cooked a five-course dinner for 208 soldiers in a few minutes over an hour, and burned only six pounds of wood—about half a dozen sticks of kindling.



Automatic Conductor Makes Change on Boston Trolleys

IF you have ever had to wait in the jam on the rear platform of a trolley while the conductor fumbled for change, you will appreciate the value of this automatic cash-register for trolley-cars invented by Samuel J. Bell, for several years a conductor on the street-railway lines of Springfield, Massachusetts.

If you drop in the right fare, it will simply ring it up. If, however, you have to deposit too large a coin, it will return the correct amount of change in double-quick time.

When, as in Boston, where it is being used, there is a seven-cent fare in operation, requiring endless changing of dimes on the part of the conductor, the automatic conductor is especially useful in lessening confusion and delay. Incidentally, if a passenger wants to pay two fares out of one coin, he can press a button and the register will deduct for two instead of one, returning the right amount of change.

Pouch for Smokers Fastens like Aviator's Coat

THE same kind of a locking device that has been used by aviators to fasten their flying-suits tightly enough to resist the elements and the terrific air-blasts they meet in flight is employed to make this tobacco pouch leak-proof.



Partly opened to suit a cigarette smoker

One of its features is that it permits the opening of the pouch to any extent desired—enough to let out the little stream of flakes required by the man who "rolls his own," or at full length to admit the pipe-bowl for filling.

Divining-Rod Is Poor Guesser

AUSTRALIA'S Royal Society of Victoria has decided, after an investigation of the divining-rod as a water-finder, that it "was a subject for investigation by the psychologist rather than the geologist." Discoveries are sometimes made by chance, but few hear about the many failures.



The concert strains come to them down the kite-string by means of a portable wireless outfit

Is Your Mind Working? Test It!

Puzzles will do for your brain
what sports do for your body

A Mental Athletics course, conducted by Sam Loyd

Twenty-Five Dollars in Prizes

POPULAR SCIENCE MONTHLY'S puzzle-tests in every-day problems of science and mechanics make up a course of mental athletics for the man who wants to keep his brain alert to meet the big tasks of life.

Educators say that puzzle-solving is the best kind of mind-training—best, because it comes as sport instead of drudgery. Sam Loyd's most faithful puzzle fans have been inventors, engineers, and business men.

A First Prize of \$10 will be awarded the reader who sends in the best set of correct answers and analyses covering the four following puzzles; a Second Prize of \$5 for the next best set; Ten Other Prizes of \$1 for the ten next best sets.

Answers must be received not later than November 8, addressed to the Puzzle Editor, Popular Science Monthly, 225 West 39th Street, New York City.

By "best" is meant, first, absolute correctness of solutions. Then, if other points of merit must be considered in the selection of prize-winners, clearness of analyses will count. Mr. Loyd's decision must be accepted as final. In case of a tie, each competitor will be awarded the full amount of the prize tied for.

Answers and names of prize-winners will be published in the February issue.



Decode the Radiogram

ALL kinds of codes are used to insure secrecy to wireless messages. One type favored is that formed by mixing up the letters of the alphabet, yet it may be easily deciphered by any one who takes the trouble to find the average frequency of the letters of the alphabet. What does this mean to you?

XT E FJXSB FEYEHUSK PXOV
OPDOVXJGK DT E FJSB EHG OP-
DOVXJGK DT E IDRHG OVUH VDP
CEHN IDRHGK GDUK E FJXSB
PUXAV?

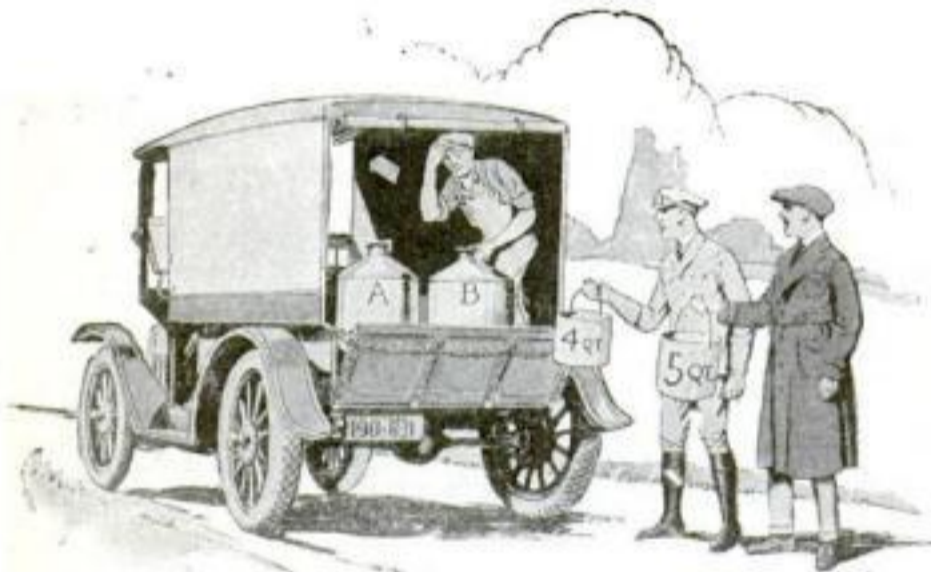
It may help you to know that the relative frequency with which letters occur in English is: A, 85; B, 16; C, 30; D, 44; E, 120; F, 25; G, 17; H, 64; I, 80; J, 4; K, 8; L, 40; M, 30; N, 80; O, 80; P, 17; Q, 5; R, 62; S, 80; T, 90; U, 34; V, 12; W, 20; X, 4; Y, 20; Z, 2.

Incidentally, the decoded message will be found to contain a simple arithmetical proposition for you to answer.

Stumping the Carpenter

CARPENTERS are natural-born puzzle-solvers, but here's a problem that held two of them up for quite a while recently. They wanted to convert that oblong piece of parquetry shown in the sketch below into one large square, without wasting any lumber. The cutting had to be done along the lines of the small squares to preserve the pattern.

What is the fewest possible number of pieces which, put together again, will form a square?



How Did He Do It?

IT'S easy enough to measure out accurately any required quantity of gasoline when the garage-owner has a standard "gas" pump at his service. Without one, he's liable to find himself faced with many a problem in accuracy if he tries to be as exact in his measurements as most garage-owners are.

You can see that it took an ingenious "gas"-dispenser to get out of this predicament without loss or unfairness: He had run out of gasoline and was returning from an obliging neighbor's with two full ten-gallon cans, when he encountered two desperate autoists who simply had to have a little of the precious fluid to carry them along to the next station.

"I didn't want to rob my own customers who were waiting for me," he said, "but I agreed to let them each have half a gallon. Then we found that none of us had a measuring-can. The best they could produce were two pails, one holding five quarts and the other four quarts. However, by pouring the "gas" to and fro between my cans and their pails, I managed to give them each their two quarts measured exactly—without guesswork."

Can you explain how he did it?

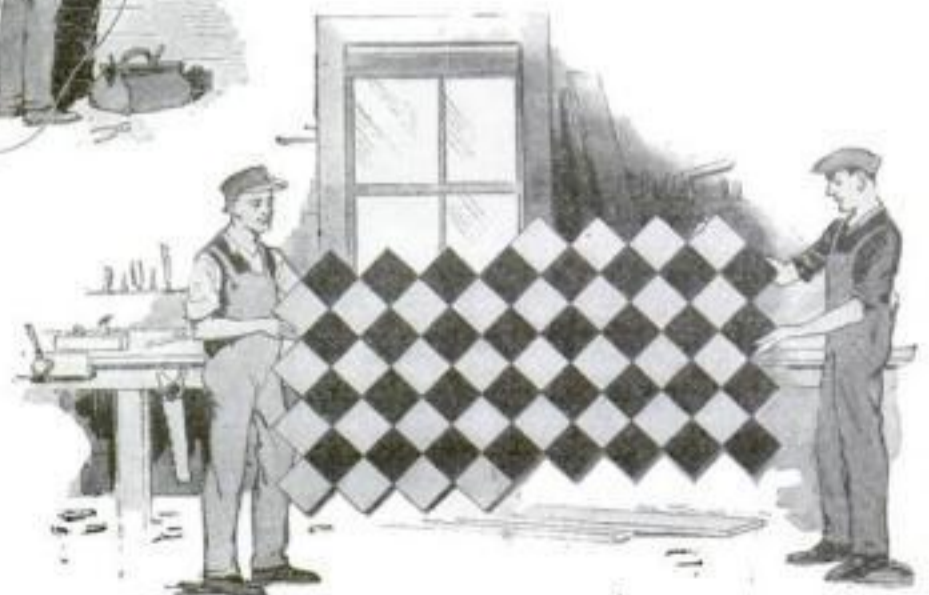
For Electricians

WIRING presents unlimited chances for baffling problems. Take the example of the electrician, given the job of connecting an annunciator in a hall in which a political meeting was to be held, so that the "boss," with a push-button, could signal orators when to stop.

The wall was 12 ft. wide, 12 ft. long, and 30 ft. high.



The wire was to be strung along floor, walls, or ceiling from the annunciator, 3 ft. from the ceiling, center of rear wall, to a push-button 3 ft. from floor, center of front wall. Ignoring all other considerations, what is the shortest possible stretch of wire?



A Touch of Efficiency at Home



Time and labor and waste are saved when the scrubbing brush has its supply tank attached. The flow of cleaning liquid is controlled by a finger on the plunger.

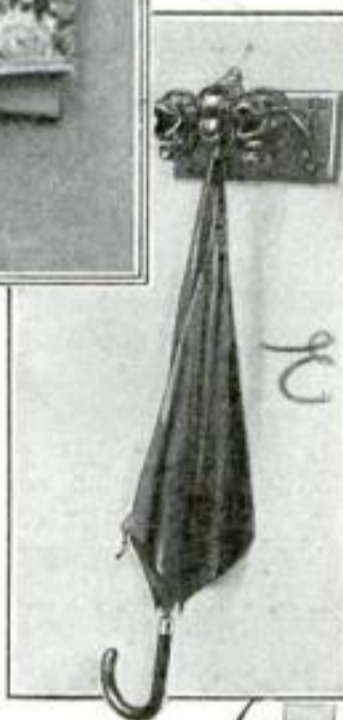
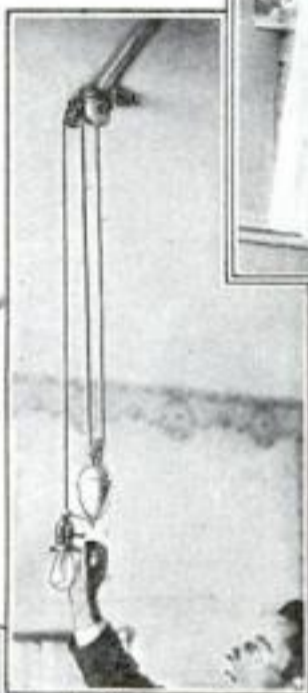


No clinging to the ledge in peril of a drop when you wash the outside of the window with this device. It is operated from the inside and held by a stirrup. The arm moves the cloth, guided by the inside lever.



A wooden knob, handy for the smoker when he wants to knock ashes out of his pipe without tipping half of them on the table, rises conveniently from the center of this ash-tray.

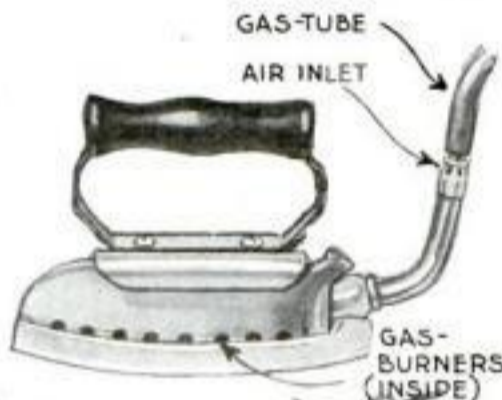
Here is de luxe service for the slug-gard who reads in bed—an extension light that may be pulled down from the ceiling. Materials are obtainable in hardware and furniture stores.



When your umbrella is wet, hang it point upmost so that the water will drip off the ribs instead of rotting the material. This new holder offers the means for doing this.



The idea is to enable him who likes lemon-juice on fish to get it there without wetting his hands, and to extract all the juice. A skewer transfixes the bit of lemon and the little squeezers do the rest.



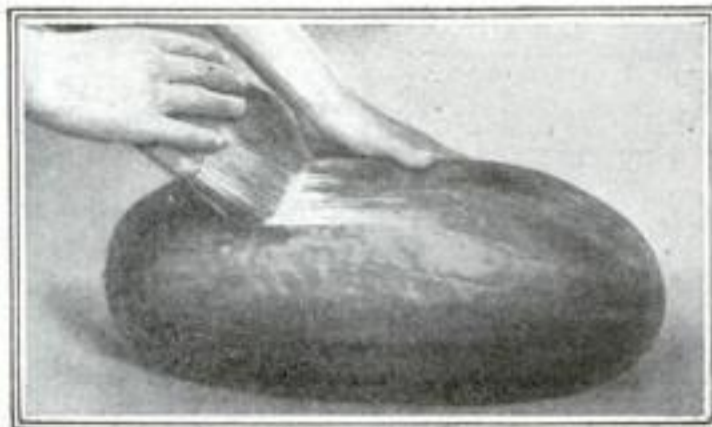
Lack of electricity needn't deprive you of a constantly heated iron. This gas-burner will supply an even temperature at a cent for three hours.



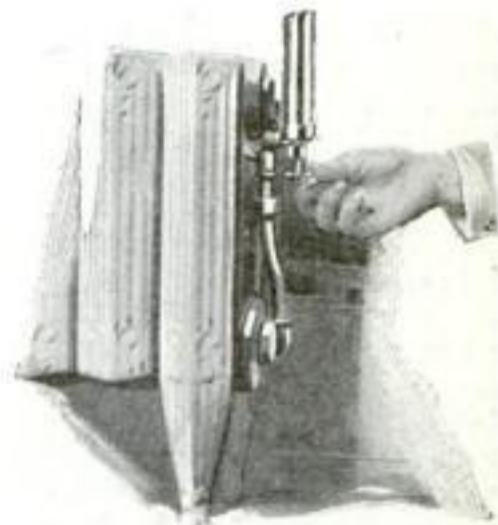
The twin plug doubles the service of the ordinary connection point, permitting the user, for example, to get light and power from the same receptacle. In an office it would serve both lamp and fan.



There would be less lingering late at the office if every man could have a home-work table like this. It will fit even the smallest apartment.



Save the surface and you save all. Give the watermelon a coat of paint in August, put it in a cool place, and it will keep through January.



To meet the complaint that steam heat makes the atmosphere too dry, this special steam-emitting valve has been evolved to keep the humidity right.

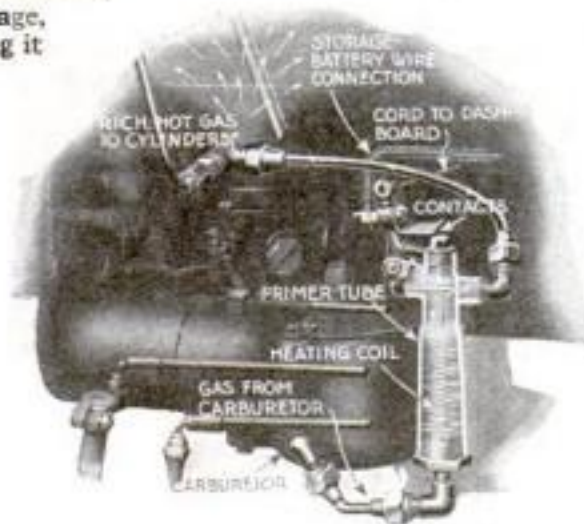
Boils Gas for Quick Start

WHEN gasoline has become thoroughly chilled in a car, the only way of starting the engine surely and instantly is by the application of heat. The car-owner may apply that heat by pouring hot water over the carburetor bowl and intake manifold, or he may apply it quickly and economically by means of a mechanical device, shown below.

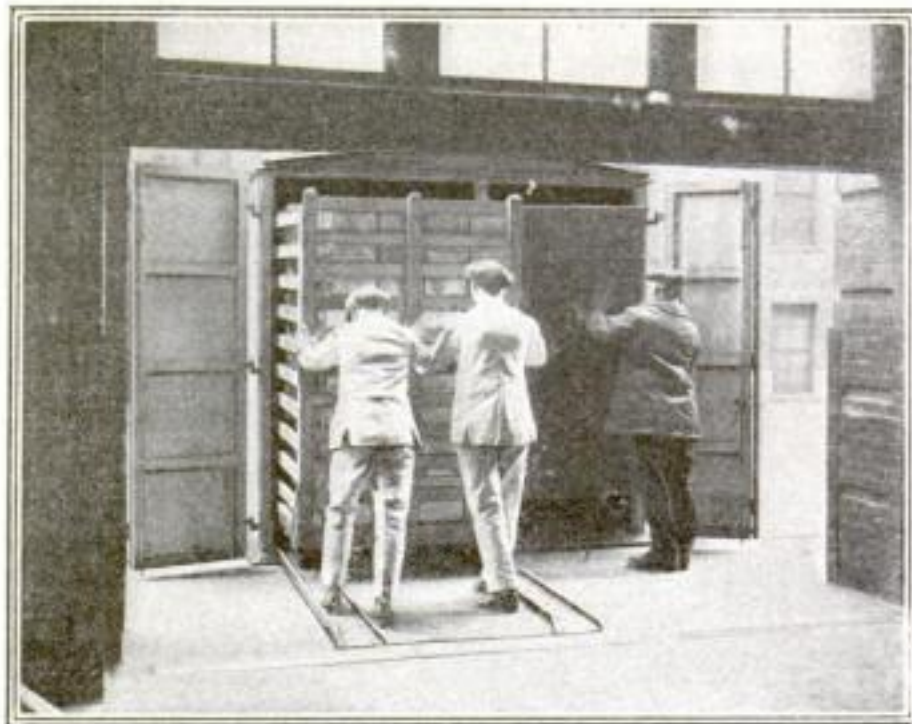
The apparatus consists of a short vertical tube which is filled with gasoline from the bowl of the carburetor. In the center of the tube is a coil of nichrome alloy wire, which is energized by current taken from the car storage battery when the driver pulls a button on the dashboard. When the coil is energized, it boils the gasoline instantly and transforms it into a rich, hot gas that automatically forces its way out through a short pipe into the intake manifold. If the engine is then turned over by the self-starter with proper ignition, it fires instantaneously. There is no danger

in boiling the gasoline, because there are but a few drops in the tube; also the coil is entirely immersed and the tube is airtight.

The use of such an instrument, besides saving the temper of the car-driver on many occasions, also saves gasoline and the waste of current and running down of the storage battery when the motor has to be spun many times on a cold day. The primer may be installed readily and may be applied to every make or type of engine.



On cold mornings this electrically heated device will boil the gasoline as it passes through the manifold, causing the engine to start instantly



Crackers are a difficult product to handle without breakage, but these nested bodies do it safely and save time doing it

Trucking Crackers Cheaply

MANUFACTURERS of crackers and biscuits have finally solved their particular problems by using a "nest body," a nest body being one that fits inside of a conventional body as mounted on the truck chassis. For crackers, such a body takes the form of a small wheeled platform with vertical slat sides and ends that support the tins of biscuits when the latter are piled one on top of the other on the platform proper. One of the slat sides is made in the form of a hinged door so that the orders can be made up in advance by men in the factory and the whole nest body rolled into the conventional truck body without detaching the truck.

The use of nest bodies solved a part of the problem, but immediately set up another one—how to get the bodies into and out of the truck bodies when the loading platform at the factory was a different height from those at the unloading points.

Here is the answer: Six nest bodies, holding in all about seven hundred tins of biscuits, are rolled into the body of a five-ton truck in fifteen minutes. The biscuits so loaded are not peddled to the individual stores, but are hauled from the main factory to the distributing substations. In this work, the trucks used to make two trips a day by the old loading and unloading method, but by saving one hour on each trip with the nest bodies, the trucks make three trips a day.

The nest bodies are rolled into and out of the truck body with ease, no matter what the height of the platform, by means of hinged tailgates provided with channels to guide the caster wheels on which the nest bodies are mounted. The tailgates are permanently hinged to the floor of the truck body. They equalize differences in height and are swung upward when not in use.

Next, the All-Purpose Farm-Truck

AN all-around farm tractor of about thirty-five horsepower is meeting with considerable success in Germany, where it was invented. It consists of an agricultural truck with a short body resting on three wheels.

A cultivator, which consists of a large drum with several rows of cutters, can be attached to the tractor, when required, by means of heavy bars connecting the axle of the drum with the axle of the drive-wheels of the truck. The cultivator attachment can be quickly disconnected so that

the truck may be used for other purposes.

The drum is driven by a gasoline engine and makes between fifty and eighty-five revolutions a minute.

When the cultivator is in use, no additional work is imposed on the engine of the tractor, as the drum has its own power, independent of that of the truck.

The cutting-knives are mounted on four cylindrical rollers, which are rotated by a gear driven by the same engine that drives the drum. Each one of these rollers has twenty or twenty-five cutters that are interchangeable.

Four kinds of knives of different size and form are used.

The usefulness of this agricultural tractor may be greatly enhanced by adding an automatic sowing attachment in the rear of the drum with the cutters.

The tractor without the cultivator may be used in various kinds of work around the farm, such as hoisting, driving a circular saw, a lathe, or a grindstone.



An all-around farm-truck, so arranged that a cultivating attachment may be added, is a recent product from Germany. The tractor can also be used for hoisting or driving a lathe, etc.

Mud and Flood Couldn't Stop These Trucks

NEAR Oregon City, Oregon, one truck moved itself and three other trucks over a quarter of a mile of road covered with water to a depth of four feet.

Four trucks were running in a convoy. When they came to the inundated roadway, the drivers found the water four feet deep for a quarter of a mile, with even the fences on both sides of the road six inches under the surface. The driver of the first truck could not go through the water without stalling his engine. He and the other drivers then conceived the idea of driving the front end of the second truck up inside of the rear end of the body of the first truck, thereby keeping dry the engine of the second truck.

After chaining the front wheels of



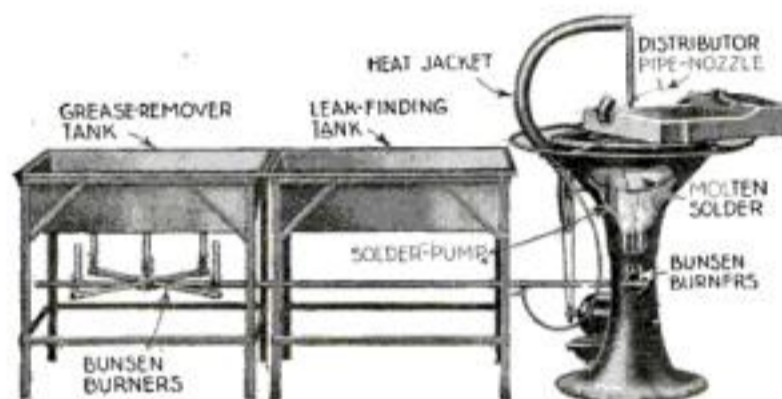
Only an ingenious mechanic would have thought of this method of traversing a flooded area



A sketch showing how one of the trucks pushed and pulled its three stalled companions

the second truck to the body of the first, the second truck pushed itself and the first truck through the water, until, by going too far off the side of the road, both became hopelessly mired in the mud and entangled with the fence. The third and fourth trucks were then coupled up as a unit in the same manner and driven past the stalled pair and a chain fastened to the bumper of the first truck.

In this order the fourth truck then pushed the third truck ahead of it and pulled the first and second trucks out of the water on to the dry roadway beyond. This in itself was a seemingly impossible task because the third truck carried a three-ton load, with the truck ahead weighing ten tons with load, and the two behind weighing twenty-three tons in all.



Leaky radiators are difficult enough to repair by hand; this outfit does it by machine

Winch Increases Tractor's Usefulness

IT was to perform such work as pulling or snaking logs, drawing oil-well pipes, and the like that the new type of winch shown herewith was devised to be permanently attached to a tractor without in any way diminishing the

tractor's usefulness or reducing its mobility as a vehicle to pull wagon trailers or stone skids.

In the oil-fields such a tractor with a winch added combines the service of the cross-country locomotive that gets the boilers, casings, and supplies to the location, with the ability to pull and run back tubing, rods, etc. In the logging-camp, skidding logs out of steep hollows or other inaccessible

places is easily accomplished with the winch and then the tractor is available to skid the trail down the mountain or pull the loaded wagons to the railroad or mill. On the farm, the winch has a great multiplicity of uses and can be employed wherever pulling power is required, such as for the removal of stumps when clearing ground.

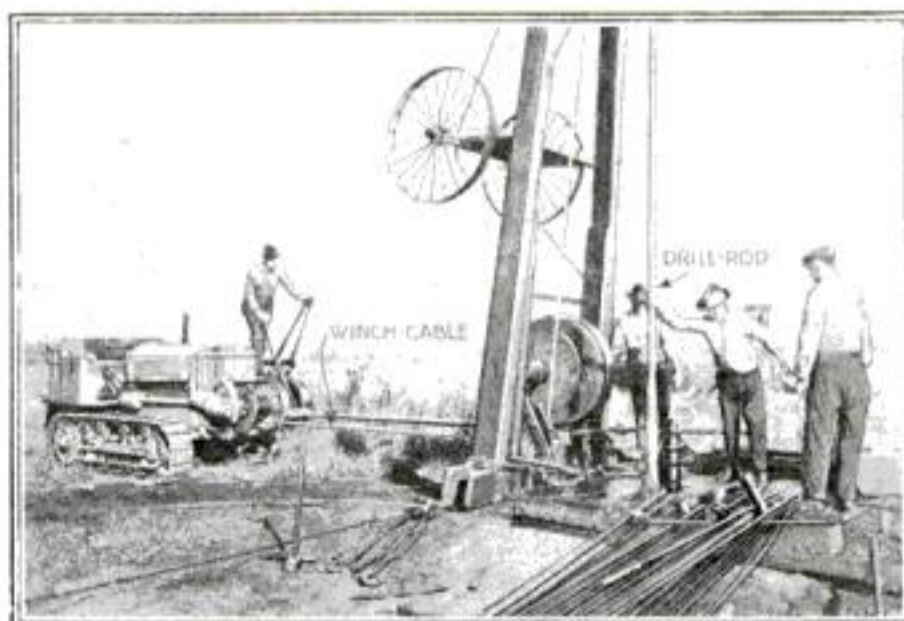
All the moving parts of the winch except the winding drum are enclosed, thereby permitting proper lubrication of parts and providing full protection for the operator. The operating power for the winch is taken from the transmission case in the rear of the tractor and carried to the winch through a gear train and propeller-shaft with the final drive through bevel gears and an internal-gear type of planetary gearing.

Reduce Repair Costs

THE radiator-repair outfit consists of three parts—a tank for removing grease and oil from the radiator core and case; a water-tank for determining the exact location of the leaks, and a soldering-stand.

This stand consists of a solder-melting bowl heated by two Bunsen burners inside the base. There is a pump inside the bowl. The pump is operated by a rope-and-pulley driven electric motor to force the molten solder out through a distributing pipe to a nozzle, from which it is forced over and around the leaks in the core. The pump is lubricated by the hot solder, which is kept liquid by a heat-retaining jacket with a priming burner.

The molten solder forced out of the end of the flexible nozzle is thinner than water. It has a surface tension that permits it to bridge a fairly large crack without running through and filling the tube.



A five-ton winch that is permanently connected to a tractor, which is now at work in Gypsy oil field, Oklahoma

Autos Are Cleaned by Air Hose

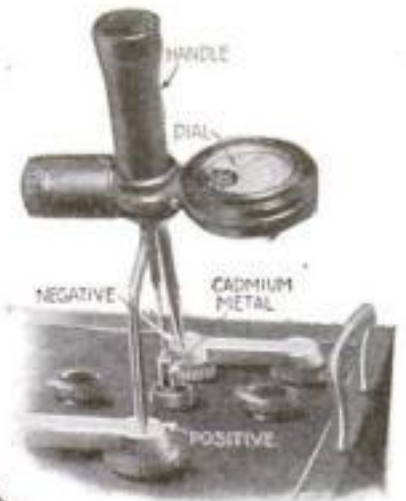
DEPOSITS of oil and dirt can be readily cleaned from automobile engines and frames by air pressure. The apparatus consists of a long nozzle through which a mixture of air, oil, and water is sprayed on the part to be cleaned at a pressure of about ninety pounds to a square inch.

The spray is directed against the surface from a distance of approximately eighteen inches and at an angle of 45 degrees.

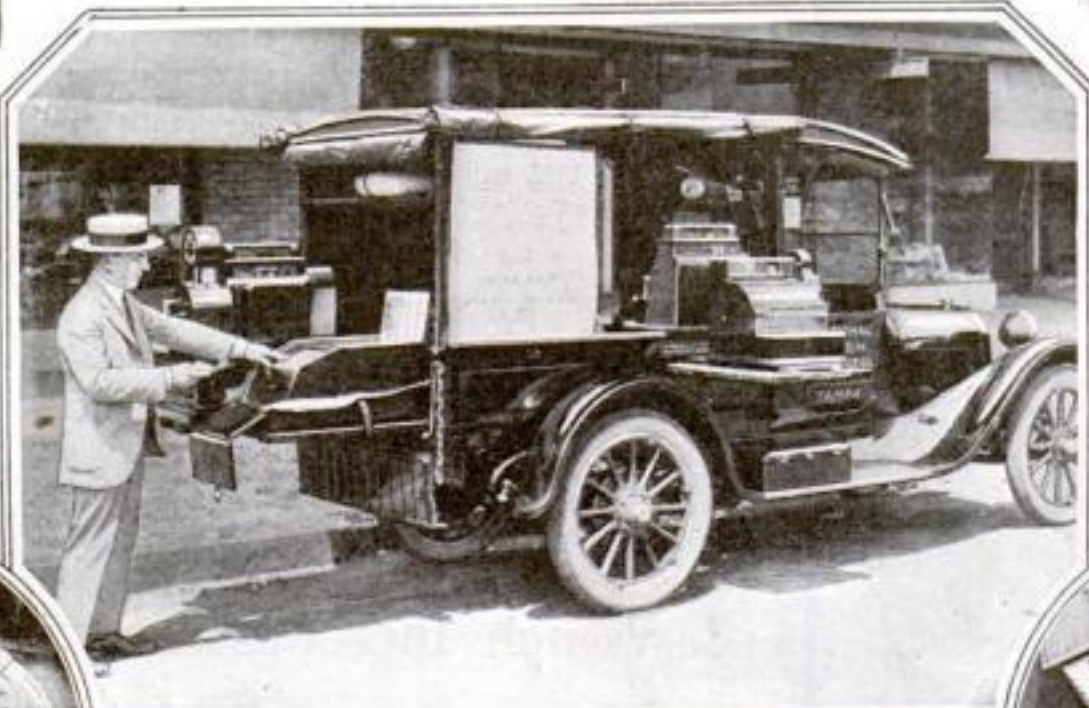
Clever Innovations Increase the Motorist's Pride in His Car and Help the Farmer



This instrument tells whether a condenser is open or short-circuited, and whether it is the proper capacity for the ignition system. 110 volt a. c. is connected to the upper binding posts and the condenser is attached to the clips below



This cadmium testing device allows each group of positive and negative plates in a storage battery to be tested independently, giving capacity and condition. The indicator reads the cell voltage and the capacity of the plates simultaneously



A salesman who believes in the efficacy of personal demonstration has arranged his car to show his goods in action, just as they will be in the prospect's store



Jacking up the car without spoiling the crease in your trousers or soiling a light shirt is easy with this geared jack with its extensible handle. It is of the screw type and cannot slip, while two gear wheels make lifting easy



Worn axle parts often allow grease to work through the housing into the brakes. This trouble is avoided by a spiral spring that revolves with the live shaft end and constantly works the grease back to the differential



Inserting a ball-bearing member between the leaves of laminated springs makes the car ride more easily. The device will remain in place without the use of screws and bolts. Substituting rolling for sliding friction reduces wear on the springs



Tight nuts in inaccessible corners are easily persuaded by a ratchet wrench long enough to reach anywhere on the car. An adjustable crossbar and thumb-rest give to the ratchet the rigidity of a solid tool



To enable a truck to work in deep sand two cogged rims were bolted outside the pneumatic tires. The truck works around a gravel-pit without any tractive difficulty whatever, as has been frequently demonstrated by enthusiastic operators



A line-drive for farm tractors has been perfected whereby the operator can "ride the load" and guide the tractor like a horse by reins attached to two gear levers. The tractor is stopped and started by pulling on the reins, just as would be the case with a team of horses

When You Want Expert Advice About Your Car

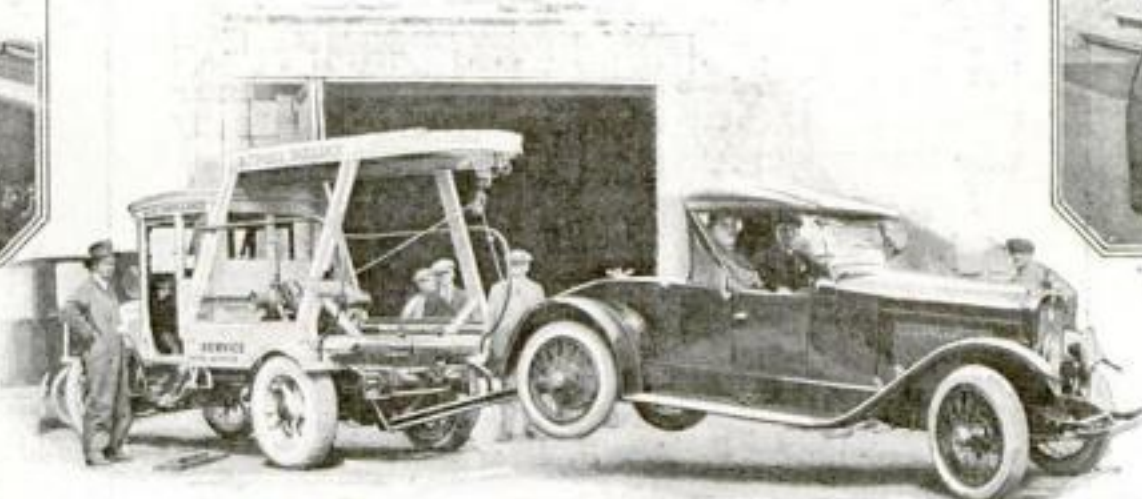
IN these pages of ideas about automobiles and motor-trucks the Popular Science Monthly endeavors to help its readers solve problems of maintenance and repair. But there must be special cases that are not cov-

ered, and we invite you to write to the Automobile Editor and let him advise you.

If you wish to know more about the devices pictured here, or if you want to ask questions, write. See some answers on page 80.



Auto lock, invented by E. A. Parrish, fastens the steering-wheel, gas, and spark levers in such a manner that movement is impossible. Its outstanding advantage is that it may be used by the driver without leaving his seat



This auto ambulance can drag a disabled car from a ditch by a hoisting apparatus able to lift 10,000 pounds. It can pick up a car from the rear without injury



To prevent the tires from being injured by the sun, slip this protective cover over them. The cloth may be removed and washed



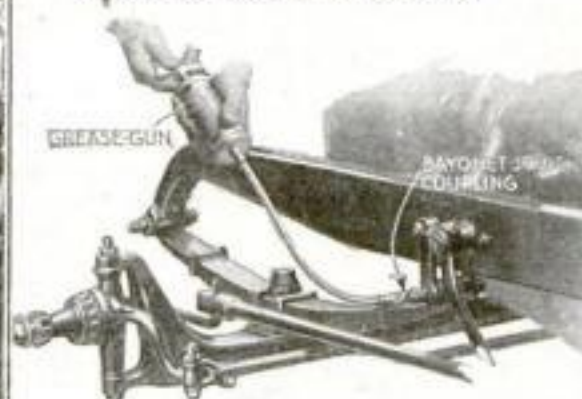
A folding seat allows an extra person to ride in the motorcycle sidecar. When not in use, it folds forward under the hood or may be detached altogether



This vacation bungalow solves the problem of a lodging for the tourist. It is mounted on a light car. The building will accommodate three people



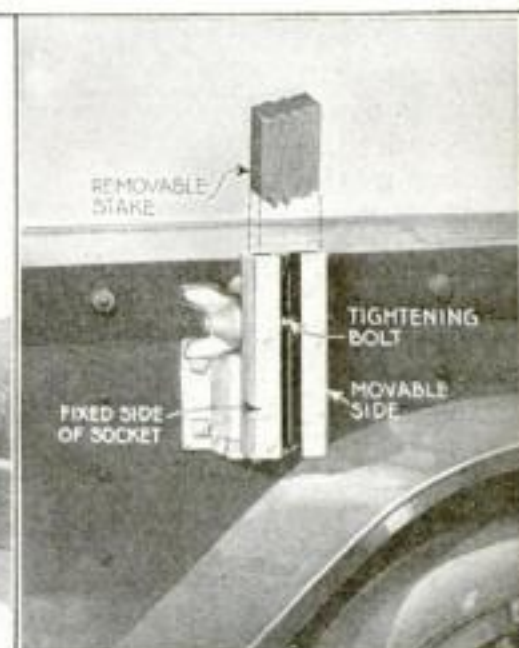
A half turn of the wrist locks this dust-cap over the valve-stem, and no vibration will shake it off. The old method demanded from twenty-six to fifty-two complete turns



Shooting the grease into the chassis with a gun eliminates the grease-cup. Grease can be forced wherever it is needed and the squeaky car is unknown



No use of the motor-truck is more important for the community than its service in building new roads through undeveloped territory. This car is carrying cement and crushed stone. The high load-body is designed to increase the height of the piles at the dump



An adjustable socket will take any size of side-stake required by an automobile truck. A threaded T-bolt passes behind the socket, which is clamped or opened by a wing-nut

Careful Inspection and Complete Records Reduce Truck Operation Cost

How expert oversight keeps the truck wheels turning

By Joseph Brinker

INSPECTION is the very foundation of successful motor-truck maintenance," said a prominent truck-owner in reply to a question as to what he considered the most important factor in keeping motor-trucks running true to schedule.

"More than that," he continued, "I consider inspection the 'all-seeing eye' upon which depends not only the cost of maintenance and the cost of delivery, but the very life of the truck itself.

"Without adequate inspection, truck costs are bound to be excessive, the life of the truck short, and dissatisfaction general."

Coming from an expert on the subject, the consideration of inspection as an "all-seeing eye" is a new thought which all truck-owners may apply to their own business with profit.

But what is this inspection? And how is it put into practice?

Again the expert goes on record that there are two methods of truck maintenance. In both of these inspection plays the major part.

The first method is that of the periodic or yearly overhaul with monthly inspections.

The second method is based upon a daily, weekly, and monthly inspection so thorough that no lengthy overhaul is required.

The first method is that most generally followed by the small truck user, who, because of the lack of adequate facilities, lays up his trucks once a year after the first or second year they are in operation and subjects them to a thorough overhauling. During this work the body is removed from the chassis, leaving

Save Time and Money by Inspection

"A stitch in time saves nine" is an adage that applies with particular aptness to the handling of the motor-truck fleet—to which may be added another to the effect that "It's better to be penny wise than pound foolish."

Frequent inspections may seem to promise the unwinding of much red tape annoying to the company and liable to keep drivers on edge, added expense, and loss of time.

But balance against this the cost of the "nine stitches"—laying up the truck for a long period after an unwatched fault has developed into a breakdown—or the pound foolishness of the periodic overhauling with its time losses.

"Inspection is the very foundation of successful motor-truck maintenance," quotes Mr. Brinker from a prominent motor-truck owner in this seventh of Popular Science Monthly's series of articles on motor-truck management.

the major parts of the mechanism free for easy removal. The engine is generally lifted out; the gearset and clutch removed and disassembled, and even some of the frame rivets renewed. Once the engine is removed, it is taken apart entirely and worn parts renewed.

The smallest chassis defect is remedied either by a new part or bushings. This work may keep the truck out of service for two full weeks, or even three weeks, if the body is painted and

of the truck fleet increases, and the unit-repair system explained in a previous issue may be put into operation. The determining factor in this system is the thoroughness of the inspection and the machine-shop equipment and parts kept on hand.

One owner of a large fleet of motor-trucks employing this system has put his truck inspection on a five weeks' schedule, with one full day given to each truck. The inspection includes the adjustment or replacement of small

parts or even of entire units, if necessary. The entire system is based upon the unit system of repairs so that reserve engines, rear axles, gear-sets, radiators, etc., may be renewed during inspection. This eliminates the necessity for the complete overhaul, as a truck is kept continually in good condition and one day's time is ample to install units that may need replac-

re-varnished at the same time that the engine repair work is being carried on. Although this work is done yearly or once every two years, according to the class of haulage performed and the mileage run, the truck must be kept out of service for two or three weeks at a time. In the case of a five-ton truck hauling for hire, with a possible revenue of thirty-five dollars a day, this enforced lay-off represents a lost income of four hundred and twenty dollars for a lay-up of twelve working days.

In the second method of maintenance, an attempt is made to reduce this idle time during repairs by a system of inspection in which the trucks are maintained as they go. This method becomes of greater and greater value as the size



When all inspection reports are centered at the desk of a maintenance superintendent, it is a simple matter to keep tabs on truck operation

ing. Furthermore, the mechanics are taught to specialize, insofar as it is possible, on different units in the truck, so that all such units as the engine, gear-set, rear end, etc., may be replaced during an inspection of one day's duration. This form of maintenance makes it possible to adhere to a definite schedule as to the time of replacing units and to have on hand at all times completed units to provide for emergency replacement.

Keeping Accurate Records

In order to prevent any essential parts from being overlooked during such an inspection, it has been found desirable to carry on the inspection work by the aid of a chart. This chart should have the different parts to be inspected arranged in sequence so that each part may be inspected in order without a continual retracing of steps. For example, if the inspector begins at the front of the truck, he should examine first the bumper and then the starting-crank. Turning over the crank simultaneously indicates whether the engine compression is sufficient and whether the motor bearings are badly worn. Proceeding in his work, the inspector should then examine the radiator and its supports, the fan-belt, the water-pump connections, the cylinder manifolds and petcocks before proceeding to the truck-cab with its various parts, or the clutch, gearset, or rear axle.

The inspection should be conducted in an orderly way from one end of the truck to the other, although for speed, two inspectors may be assigned to each truck, one working from the front toward the middle, and the other from the rear toward the middle. Still greater speed may be secured if two inspectors and two helpers are employed.

Only when a record is kept of the work done and its cost is this

system of maintenance inspection of any real value in the continual fight to reduce repair costs. These records, when properly analyzed, give the owner many significant facts based on actual experience in his own business. These facts may enable the owner to

should be followed up each night by the garage mechanic, who should sign his name on the report-card after he has completed the work. This serves to place the responsibility should the same trouble again develop within a short period.

From these daily maintenance reports, valuable monthly reports may be made up, covering both the nature of the repair work done and its cost. When properly filled out, monthly records of this kind show the owner many significant facts. For example, an especially high maintenance cost for one month and an especially low maintenance cost for another may indicate a tendency to neglect the repair work at one time of the year, or again may indicate a special severity of work during a certain portion of the year. It may also indicate the influence of weather conditions and steps may be taken to overcome such conditions.

Driver and Mechanic Cooperate

In the comprehensive monthly inspection system, some owners have found it a good plan to assign the driver of the truck to the mechanic in charge of the inspection. In this manner the driver not only learns a great deal about his truck, but is made to feel the responsibility of taking care of it properly during the intervals between the inspection periods.

Further benefits may be secured from the monthly inspection reports if they are used to form another report covering a period of years. Some facts that may not show up strongly when considering the monthly reports individually, may indicate a very decided trend in a yearly chart. This is especially the case as regards total yearly costs of repair and indicates to the fleet-owner the point at which the yearly



No important part, however small, should be overlooked by the inspector during his daily check-up before the truck leaves its station

INSPECTION CHART		
INSPECTORS WILL NOTE CONDITION OF EACH PART IN THE ORDER ENUMERATED BELOW		
DATE	INSPECTOR	REPORT ON LUBRICATION AND PARTS NEEDING ATTENTION
Sept 1-20	John Smith	
1 WORM-GEAR		
2 WORM-WHEEL		
3 REAR AXLE		
4 RADIUS ROD		
5 HAND-BRAKE ROPE		
6 STEERING KNUCKLE		
7 BB		

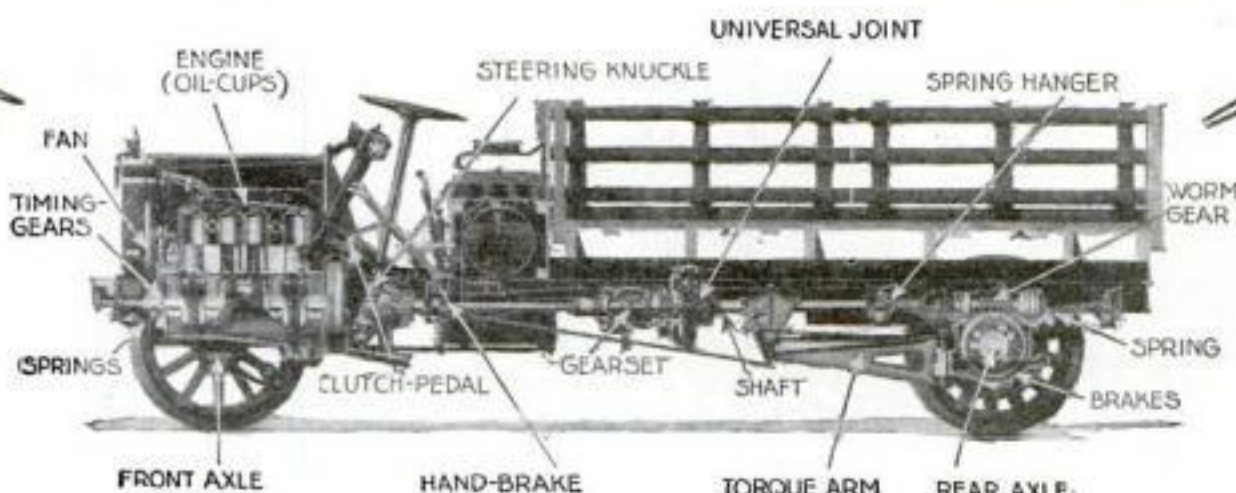
A sample inspection blank that helps the inspector to be thorough by listing the parts to be watched

draw important conclusions affecting the very foundation of his system of haulage or delivery.

All maintenance records begin with the driver. Because the driver is in closer touch with his own truck than any other man, the driver's daily report-card of work done should be utilized to the fullest extent to indicate any truck troubles that may have developed during the day. Any suggestions that the driver may make as to needed repairs or adjustments



A full oil-can used with discretion is one of the biggest aids in keeping trucks moving regularly out of the owner's garage



The arrows point to the parts of a motor-truck that require the closest scrutiny by the inspector in his daily round



The grease-gun, like its ally the oil-can, plays a mighty important part in achieving efficient and continuous truck operation

maintenance cost may become so high as to make it more economical for him to discard his old truck and replace it with a new one.

Special Engine Record

Still other facts may be secured from a record of the inspection report. For example, a special record kept on engine repairs may indicate such an excessively high cost as to make it worth while to investigate the fundamental design of that part and to determine if some other type of engine would not give better satisfaction. This same thought may be

"How I Keep Down Car Expenses"

DO you? If you do, and if you can tell fellow readers how you do it, you can make a 500-word letter bring you \$35.

Popular Science Monthly will give a prize of \$35 for the best letter on this subject received before November 1; \$15 for the second best.

You don't have to be a literary or an inventive genius to win. It costs American motor-car owners more than \$5,000,000,000 to operate their more than 10,000,000 motor vehicles. That's too much. The fact that you are a reader of Popular Science Monthly makes it a safe bet that, if you are a car-owner, you are better informed than the average motorist on ways of keeping down fuel, wear, and repair expenses. Spread the news and, provided it's practical and really a penny-saver, you are in line for winner's position.

First Prize, \$35

Second Prize, \$15

carried further to include other parts of the truck chassis, the records for which show excessive repair costs or extremely frequent breakage.

Summing Up

Thorough inspection and a complete system of records are the means of holding down repair costs and building up truck efficiency. The traffic superintendent with one or more trucks to operate is not getting maximum results from them unless their repair and maintenance are carried out on a systematized basis, which will thus keep them longer on the road.

Write to Us About Your Motor Troubles

Popular Science Monthly invites you to send your automobile problems to the Automobile Editor. He can tell you anything you want to know about a car, and he is here to help you

About Cylinder Gaskets

Q.—The engine of my automobile has an old cylinder-head gasket, and I find that if I feed the engine hard in going up a hill it begins to knock. I have been told that a thicker gasket will end this trouble. Would the engine then have more or less power? Please answer this last question in detail.—H. K. B., R. F. D. No. 7, Lebanon, Pa.

A.—The fitting of a thicker gasket under the cylinder-head may eliminate your trouble; but we advise you first to ascertain whether the spark advance is set too early, if the gasoline mixture is too rich, and if there is a variance in the valve setting and seating to give a sufficiently lean mixture to prevent engine from knocking.

The fitting of the gasket under the cylinder-head will give the engine more power than it has in its present condition with engine knock, but will give less power than without the gasket, provided the engine knocking can be eliminated by any of the methods outlined above. All other conditions being equal, the fitting of a gasket under the cylinder-head reduces the engine power; because to increase the volume of the combustion space reduces the compression pressure.

What "Ton-Mile" Means

Q.—In figuring motor-truck operation costs, I notice many firms use the term, "ton-mile." Please explain what a ton-mile is and tell how to figure it. If a truck carried 1000 tons, traveled 10,000 miles, and cost \$3,000 to run over a given period, what would be the cost per ton-mile?—P. B., Co., Milwaukee, Wis.

A.—"Ton-mile" is a term of convenience by which the cost of doing a unit of work by one truck may be compared to the cost with other trucks. It takes into account both tonnage and mileage and is based upon the trip of the truck.

Figured by each trip, ton-mileage is calculated by multiplying the tonnage carried on the trip by one half the mileage of the trip. Figured over a given period, it is the total tonnage carried multiplied by one half the average trip distance during that period.

The ton-mileage cannot very well be calculated from the figures given unless an average trip distance is assumed. If this is taken as ten miles, the ton-mileage is 1000 times ten over two or 5000 ton-miles. The cost of each ton-mile is then \$3000 divided by 5000 or sixty cents. Ton-mileage cannot be obtained by multiplying the tonnage carried in a period by the mileage covered during the period. The trip length must be taken into account as shown.

Broken Spark-Plug Wires

Q.—How can I prevent spark-plug wires from breaking at the point where they are bent around to hold under the terminal nut of the center electrode of the spark-plug?—L. A. H., Brooklyn, N. Y.

A.—When placing a wire terminal under a terminal nut such as is used on a spark-plug, be sure to twist or turn the wire in the same direction as the nut must be turned to tighten it up.

Dim Lights on Fords

Q.—Please explain why the lights on a Ford car appear to burn brighter when the engine is speeded up or the speed of the car is increased.—X. D., Newark, N. J.

A.—Unless some form of regulator is employed, the Ford lights do burn brighter when the engine is speeded up because the current is secured from the fly-wheel generator and varies with the speed of the engine.

Horsepower of Truck-Engines

Q.—Please explain how it is possible for heavy motor-trucks fitted with engines of no greater horsepower than some passenger-cars, to move heavy loads of from five to seven and a half tons.—H. F., Fort Worth, Tex.

A.—The engines of both passenger-cars and trucks perform work when they cause the vehicles to move. Work may be defined as force multiplied by space, and power as the rate of work. Power exerted for a certain time produces work. The unit of work is the foot pound, or the amount of work done in overcoming a pressure or weight equal to one pound through one foot of space. The most common unit of power is the horsepower, which is equivalent to 33,000 foot pounds a minute. In the passenger-car, the power of any given engine moves a small weight very quickly, while in the motor-truck, through a system of gearing, the power of the same engine is utilized to move a larger weight more slowly, the amount of work done being the same in both cases.

Detecting Binding Brakes

Q.—If the engine seems to lack power or the car does not pick up speed and the trouble is diagnosed as slightly binding brakes, what is the simplest method to discover if this is the real trouble?—Q. B., Atlanta, Ga.

A.—Aside from the inspection of the brakes while another person operates the pedal and lever, one of the easiest methods is to throw out the clutch and let the car coast down a hill. If the brakes are free, it will coast easily and pick up speed.

If the brakes are binding slightly, they will tend to hold the car back and reduce its speed.

Some Ways of Keeping Clear of Steering Trouble

By Fred Gilman Jopp

THE motorist who neglects to inspect and tighten the various parts of his car is either lazy or reckless enough to take a chance. But sooner or later he discovers that the reckless motorist is rarely wreckless.

I thought that the steering-gear of an automobile was self lubricating and automatically adjustable. It wasn't, as I found to my sorrow. However, I did find (later) that the steering-gear comes nearer to being standardized than any other part of the car; that with reasonable care it will outwear all the other working parts; that for safety's sake I should keep the front tires well inflated in order to have tight but well lubricated bearings, joints, and proper wheel alinement.

"But how do you ascertain these conditions?" I inquired of my instructor.

"You first use a lot of elbow grease," he said. "To locate loose connections or worn bearings, you jack up one wheel at a time, grasp the tire with both hands, and work the wheel back and forth, taking note of the places in the steering-gear where there is any play.

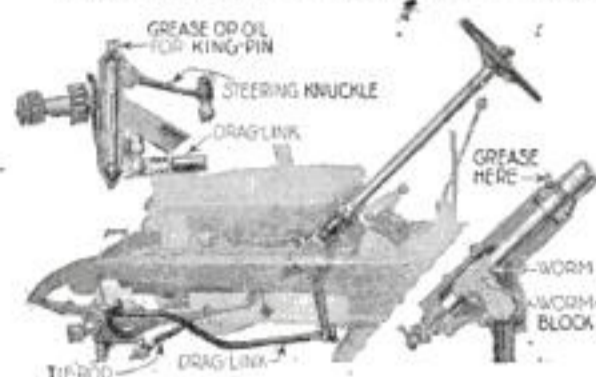
"You will expect to find looseness in the ball-and-socket joints, on the tie-rod, and the drag link between the steering-arm and the knuckle joints. Naturally, these must be free to move, but there shouldn't be any play in them. Even a little looseness in each joint will cause a lot of play in the steering-wheel."

My instructor reached down and took hold of the top and bottom of the tire and worked the whole wheel in a vertical direc-

tion. He was evidently looking for excessive movement in the wheel or knuckle bearings. He found it!

"Better get that fixed immediately," he advised; "that loose wheel-bearing will soon tear out the center of your tire tread and —"

"Wait a minute," I interrupted; "I want



Neglect to inspect and lubricate these parts of the automobile invariably leads to trouble

to jot this all down—it's information that the average motorist doesn't know."

And I pass my notes along to the reader, that he may escape the inevitable crash that comes to those who neglect their machines.

The upper bearing of the steering-post should be given a few drops of oil every thousand miles. The steering-wheel should be kept tight in the tube all the time.

The worm-gear and ball-arm only need occasional oiling. A "shot" from your grease-gun every three months is enough. Above and below the worm-gear are the

thrust-bearings. These must be kept tight. If the steering-gear is of the full worm type, as shown in the illustrations, the worm can be turned a quarter circle, provided the eccentric bushing will not keep it in proper adjustment.

The drag-link requires lubrication at the ball sockets on each end. Grease or oil it every five hundred miles. Keep the ball-sockets tightly adjusted, but not too tight, as they might bind in certain positions.

The spindle tie-rod requires lubrication and adjustment only at the forks at either end, but these should be checked once a week for alinement. If they are bent, it will throw the front wheels out of line, wear the front tires, and make steering extremely difficult.

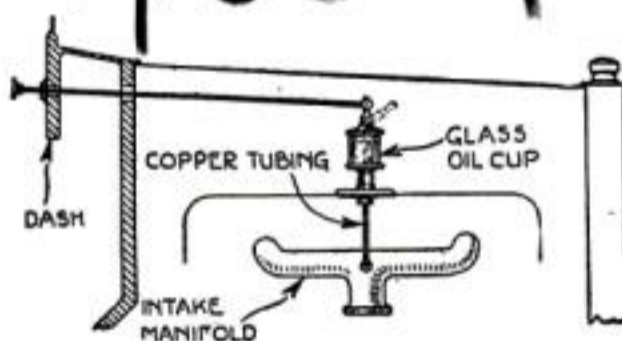
The steering knuckles also require oiling every five hundred miles. These should be kept tight enough to prevent lost motion, but not tight enough to hinder their turning freely.

Ordinarily the front-wheel bearings need tightening and adjusting about once or twice a season. Remember that the wheels will seldom wobble of themselves. However, if the demountable rim and tire are not put on properly, the tire will not run true. This will cause hard steering and a rapid wearing away of the tires.

The foregoing is all summed up as follows: plenty of oil and grease, tight joints, and proper alinement. If you can't do this work yourself, get your service station to check them occasionally. Then you won't be listed in the newspapers under the head of "Automobile Accident."

A Sure-Acting Primer for the Automobile

MANY automobiles require a sure-acting priming device to cause the engine to start firing at once, instead of compelling the starting motor to wait for



Save your storage battery by equipping your car with this simple sure-acting primer

long periods, which puts a heavy drain on the storage battery. Therefore, some means must be found of injecting into the cylinders a sufficient amount of gasoline so that enough will vaporize and mix with the air in the combustion chamber to form an ignitable mixture. The best of these is one that can be operated from the drivers' seat.

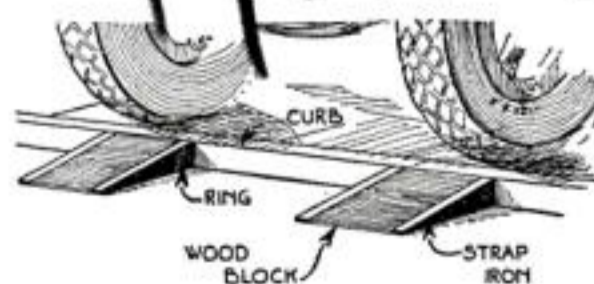
Obtain an ordinary sight-feed oil-cup, as shown in the illustration. Attach it to a suitable part of the car, such as the dash, or mount it on the engine block, above the carburetor. By the use of $\frac{1}{8}$ -in. copper pipe, like that used for the gasoline line, the cup should be connected with the intake manifold directly above the vertical tube to the carburetor. Then, by the adjustment of the feed-valve on the cup, the correct amount of gasoline is admitted to the mani-

fold in the right place. In this way all cylinders will receive the same mixture, and of course will develop maximum power.

After the engine has started well, the feed-valve cup can be closed. This method is far more reliable than priming-cups on cylinders, for, when the engine is primed through them, a greater quantity is injected than is needed for one explosion, and for this reason there is a certain amount of vapor formed, regardless of low temperature, which then finds its way past the piston-rings into the crankcase and mixes with the oil.—R. L. PRINDLE.

Curb-Blocks Will Help a Truck to Mount Curbs

TWO heavy blocks cut in the manner shown and banded with heavy iron will be very useful to carry on heavy trucks when it is necessary for them to go



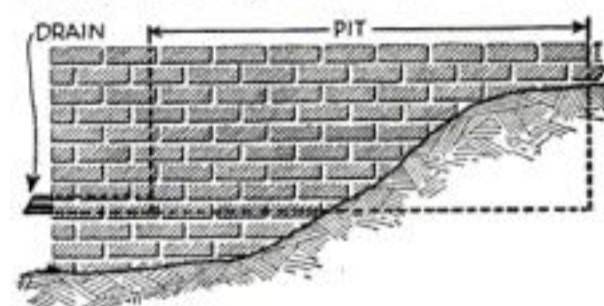
Every motor-truck should carry two of these curb-blocks

up a curbstone. A ring is attached to each one of the blocks so they may be hung on the truck when not in use.

The illustration showing the blocks and their use is self explanatory.—G. BENDER.

Garage Repair-Pit Built of Discarded Bricks

EVERY automobile owner will have occasion at times to get under his car to make necessary adjustments and repairs. An easy and inexpensive way to do this, if



Underneath repairs can be made comfortably if the automobile stands over a pit

you have the necessary material at hand, is to dig a pit 3 ft. wide by 2 ft. deep and as long as you think necessary, or according to the make of your car.

Having a truckload of old brick that I got from a paving contractor for nothing, I walled up the pit to about 3 in. above the level of the floor. I then leveled the rest of the floor with fine cinders, wetting them and tamping them firmly down.

Some of the bricks were badly worn, hence, in paving the floor of the garage, instead of laying the bricks edgewise I laid them flat over the cinders and poured a slush of sand and cement on them, sweeping it well in the cracks.

I made a small drain at the bottom of the pit toward the rear of the garage to let out the water when draining my radiator, and put in two lengths of 3-in. sewer-pipe.



The Home Workshop

New and Useful Things for the Practical Man to Make

A Wireless Telephone Receiving Set for Ten Dollars

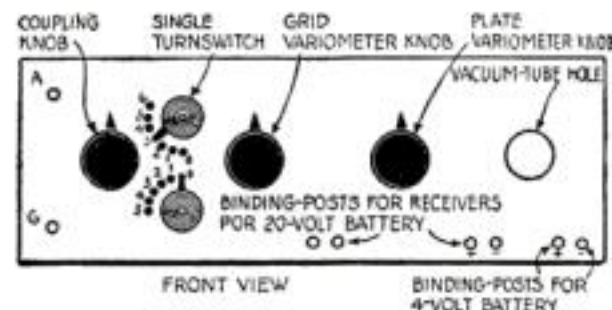
Receive radio music and vaudeville in your home

THE following directions are offered in the belief that they will enable even those who know nothing about electricity to build a wireless telegraph and telephone receiver, with which they may enjoy listening to messages from near and far.

The various parts should be mounted on an upright panel of wood or other material, and which will be referred to as a "panel" from now on.

The vario coupler is nothing more nor less than a tube, mounted in an upright position, around which have been wound fifty or more turns of comparatively light insulated copper wire, together with another coil of wire, wound around a similar, but smaller tube, which is mounted in any convenient way that will allow it to be turned in a plane at right angles to the plane of the upright coil. Cardboard forms or tubes may be used. They should be coated with shellac. Try to keep their dimensions near those indicated in the drawing.

For the vario coupler, it will also be necessary for you to procure two switch arms,



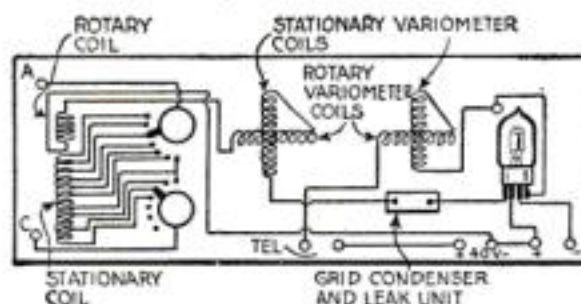
Here is shown the front view of the panel on which all the working parts are mounted

of the general type shown in the drawing, as well as a dozen or so switch contact-points. Neither of these items have to be of any special design and any radio dealer can supply you with them. Then it is also necessary to procure a brass rod which is used as an axle for supporting the rotary part of the unit. A knob, of almost any material, may be placed on the end of this rod, either by having the rod screw directly into it or having it fastened with nuts and lock-washers. The knob is used to turn the rotary element.

Then it is also necessary to procure enough copper wire to wind the turns on both the vertical and rotary sections of the vario coupler. Number 20 single cotton-covered copper will be right, but wire of slightly different size may be used. It will be found advisable to insert a round block of wood into the bottom end of the vertical section of the unit, by driving brass tacks through the tubing and into the block. This allows the vertical section to be screwed to a base, which is the best method of mounting it. Every few turns are marked and a wire lead is

By Arthur H. Lynch

soldered to them. These leads should be soldered to the vertical section while it is being wound. The best way to do this is to twist the wire you are winding, so that a little projection is formed, as illustrated, to which the leads may be soldered. In wind-

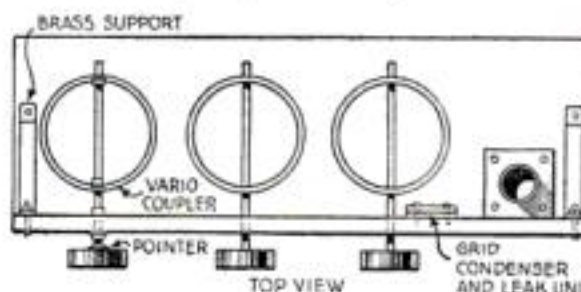


This diagram illustrates the general arrangement and the wiring of the radio equipment

ing the vertical section of the vario coupler, which is called the "primary," it is well to start from the top, being sure to leave enough room in the upper part of the tube to allow the rotary axle to pass through and be fixed in place without interfering with the winding on the vertical form.

We then come to the rotary winding, which is called the "secondary" of the vario coupler. It will be seen that half of the winding is located on one side and half on the other side of the axle. The two ends of the rotary winding pass through holes in the cardboard form, in order to hold them in place, and are soldered to pieces of flexible insulated copper wire of any convenient size. The green-covered wire such as is used for Christmas-tree lights will do.

In selecting the forms for winding the variometers, it is but necessary to remember that they may be of any desired thick-

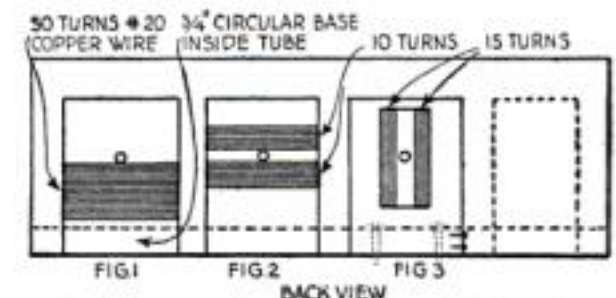


Top view of the panel, showing position of variometer parts and their respective knobs

ness that will hold its shape and that the smaller ones must be rotatable within the larger ones. The same general directions follow for the winding of these coils as were outlined for the vario coupler, except that in winding the vertical or upright sections it will be necessary to leave enough room for the axle to pass through the center of

each winding. In the case of the variometers, it will be seen that one end of the outside winding is connected to one end of the inside winding, of each unit. This connection should be of flexible wire and long enough to allow the rotary part to make a complete turn. As in the case of the vario coupler, you must procure axles, knobs, and the other fittings illustrated.

After drilling holes in the panel for mounting the switch-points and switch-arms for the vario coupler, the leads from the primary may be fastened to the switch-points as shown in the diagram, either by using the nuts which hold the points in place or by soldering the wires to the inside ends of the contact-points. When connecting these leads, they may be cut off so that they will just extend to the desired points, without being long enough to be unsightly. This practice may be follow-



In this rear view of the panel the coils of the variometer units and their relative positions are shown

ed throughout and wherever possible the connections of the wires should be soldered.

The connections for all the units are shown in the circuit diagram. It will be noticed that there is a condenser between one terminal of the "grid variometer" and the terminal "G" of the tube panel. This is called a "grid condenser" and may be had from any dealer. It is generally supplied with a "grid leak." It adds to the value of the set and should be used.

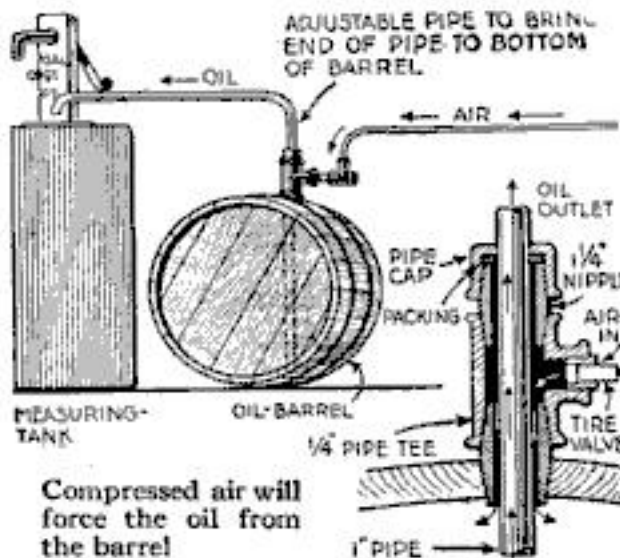
The markings on the drawing indicate quite clearly what connections must be made to the various parts and you will find that the lettering on the vacuum-tube panel corresponds to that illustrated here. The circles in the drawing indicate the binding-posts and the instruments that must be connected to them are plainly indicated.

The vacuum tube used with this particular set may be had from any radio supply house. It may be used with ordinary dry cells to good advantage. Connections should be made to the rear of the vacuum-tube panel and holes large enough to pass the wires through should be drilled into the main panel. Holes should also be drilled through both the vacuum-tube panel and the main panel, to pass the brass bolts used to hold the two together.

Transferring Oil from Barrels to Tanks

IN the garage or service station the emptying of a drum or barrel of oil into the measuring-tank is usually accomplished with considerable muscular effort and waste of time. Where a plunger pump is used, this results in wasted oil and requires the service of an employee to stand and operate the pump. Hoisting the barrel over the tank also has several objections.

A simple compressed-air lift, which can be made of a pipe and pipe fittings, and which avoids the difficulties of other methods, is shown here. It consists of a bent pipe extending to the bottom of the oil-drum with the nozzle at the height of the tank. A pipe T is fitted with two short pipe nipples, one to screw into the bung and the other fitted with a pipe cap and packing about the oil-pipe. The end of the pipe T is connected by a tire valve with the

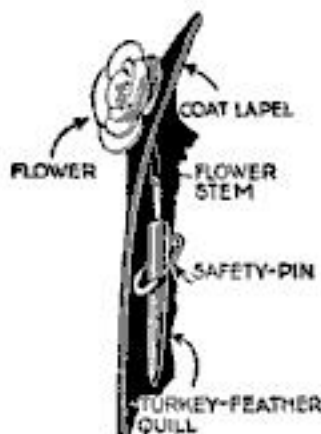


air supply. This fixture is screwed into the drum, the air turned on, and the barrel is emptied in several minutes.

Flower Can Be Kept Fresh in the Buttonhole

MOST flowers droop and wilt in a very short time if kept out of water, so that a boutonniere will last only a few hours in warm weather. The question that came to my mind was, how can water be supplied to the flower? The answer is: by wearing a buttonhole vase.

Any arrangement that is to be worn on the lapel would have to be very light, so I



Its light weight and size make a quill very suitable for a boutonniere holder

cut off about 2 in. of the butt-end of a turkey quill, cleaned out any loose particles from the inside, filled it with water and fastened it to the lapel with a safety-pin.

The flower is pulled through the buttonhole and the stem placed in the vase. No water will spill out because of the capillary attraction.

Useful Things to Do at Home

Hints that will help you in odd jobs around the house, saving time, temper, and money

How Paper May Be Cleaned of Finger-Marks

THE pages of books, valuable papers, etchings, etc., which have been carelessly handled, often are disfigured by the marks of greasy and dirt fingers. These marks can be removed by the following simple method:

Make a thick paste by thoroughly grinding up a spoonful of magnesium carbonate with a sufficient quantity of benzol in a cup or mortar, and apply a small quantity of this paste to the finger-marks, rubbing it in lightly with the tip of the finger. The benzol will evaporate in a few moments, when the paper should be brushed with a clean, soft brush.

If the first application is not sufficient, repeat the operation.

Removing Paint and Varnish from Woodwork

HARDENED coats of paint and varnish may be removed from woodwork by scraping and sandpapering, but this method is slow and strenuous and liable to injure the wood, particularly when it is carved. It is much better to remove the coating with a chemical paint- and varnish-remover.

Mix 5 parts, liquid measure, of 36 per cent sodium silicate with 1 part of 27 per cent soda lye, and 1 part of ammonia water, and apply the mixture liberally to the varnish or paint. The composition will penetrate to the wood in ten or fifteen minutes, according to the thickness of the coating, and will soon dry. If the treated coating is thoroughly scrubbed with water, the paint and varnish will come off easily.

After a thorough brushing the woodwork will be ready for a new coating of paint and varnish or for receiving an oil finish with or without a previous staining.

How to Stop Flushing Cistern Leakage

OFTEN the cause of endless hissing in a flushing cistern is due to a small leak in the ball or float valve into which water has seeped, preventing the ball float from closing the water-valve. To get all the water out of the ball, hold over a flame until the hot air has escaped in steam. Then solder.

To Successfully Screw Hooks into Plaster

TO fasten hooks (for light weights) into plaster, cut a piece of leather about $\frac{1}{4}$ in. wide by 1 in. long and pierce it in the center. Then carefully screw in the hook to form a thread in the leather. Drive a hole in the plaster with a nail, a hole that will easily chip to a width to admit the leather when doubled and the screw.

Run the leather to the point of the screw,

bend down, and push through the hole, allowing the ends to open out. The screw may now be screwed up. The rough plaster and lathing should prevent the leather from turning, or it may be held by a string. The screw hook will then be held, not by the screw in the plaster, but by a clamp made of the piece of leather and the hook's brass washer which will cover the hole.

That Broken Window-Pane Can Be Fixed

THE glazier's secret for properly renewing glass in a window is one you can quickly learn, and ever after you can avoid those mistakes that mean loose and easily broken panes.

In the first place, the old putty must be completely removed. The new glass should be ordered $\frac{1}{8}$ in. smaller each way than the frame, so that it will have an insulation of putty on all sides. If the glass touches the wood at any spot, there is danger of a crack, if not a crash, whenever the window is raised or lowered sharply. The pane should be pressed in evenly, and a bevel edge of new putty applied at the back to brace it.

In the event of there not being enough depth to the frame for a stout thickness of putty, brads or little triangular zinc wedges (purchasable at a glazier's) may be used to reinforce the putty.

Suggestions for Cleaning Floor Tiling

FOR glazed terra cotta, a rub with a dry or slightly damp flannel is all that is necessary. Unglazed tiles often show a white scum on the surface due to the action of cement and lime underneath. This scum is easily removed, but may recur. For bad cement marks, scrape and rub off. For the ordinary scummy stains and paint spots, pour a small quantity of sulphuric acid diluted with an equal quantity of water and allow to remain a few hours, then wash off; if necessary, reapply the acid and rewash.

Unglazed tiles may be brightened by rubbing with paraffin once a month. To remove inkstains from tiling, use diluted nitrous acid afterward washed off with plenty of water and an old flannel rag. Be careful with this acid. It will burn hands and clothing.

Gilding Can Be Brightened Very Easily

A MIXTURE that is said to clean gilding is made of 1 gill of water, 2 ozs. of purified nitre, 1 oz. of alum, and 1 oz. of common salt. When dissolved, brush the gilding with a camel's-hair brush soaked in the mixture.

To revive gilding this restorer is recommended: beat up well 1 oz. of chloride of potash or soda with 3 ozs. of whites of eggs.

Popular Science Monthly Is Offering Two Prizes for the Best New Ideas Sent to the Home Workshop Department Each Month

You have a chance to win the \$50 or \$25 prize

SEVENTY-FIVE dollars will be awarded every month to the authors of the two best articles appearing in this department. The first prize is \$50, the second \$25. Every article submitted will be considered as a possible prize-winner. Those which do not win prizes may be purchased at space rates. The prizes will be awarded upon publication, and the check will be mailed to the winner the same month.

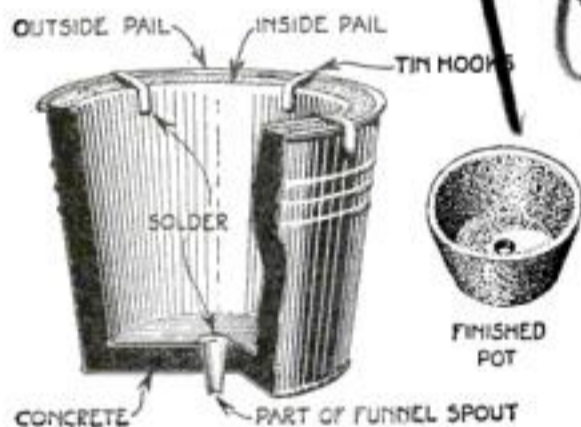
The prize-winning articles may be long—but not over 1000 words—or they may be very short. The idea, device, or machine described must be practical and ingenious: it must fill an actual need in the home, office, or shop.

This new feature must not be confused with the other prize contests which the Popular Science Monthly has conducted during the past and which it will continue to conduct in the future.

Making Concrete Flower-Pots for the Garden

DAINTY and attractive flower-pots for growing porch flowers are easily made of concrete. A pair of tin pails of the conical type and of different size serve as

hang on the upper edge of the outer pail. The smaller pail is then set inside the large one with one point of the funnel protruding through the hole in the bottom of the large pail, the tin hooks holding the weight of the inner pail, with its bottom $\frac{1}{2}$ in. from the bottom of the outer one. A mixture of coarse sand, water, and cement is poured in the space between the walls of the two pails and is left undisturbed till the concrete hardens. Then the pails are separated, leaving the pot. No large pebbles should be in the mixture that will not pass between the walls of the pails. The funnel's tip thus soldered in place, holds the inner pail centrally in the outer one and forms a drainhole for the pots.



Now is the proper time to prepare for the next planting season by making flower-pots of concrete

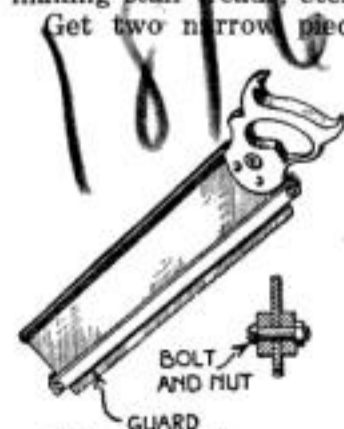
forms for the pots as shown in the accompanying illustration.

One of the pails should be an inch smaller in diameter than the others, so that, when it stands inside the large one, there will be a space $\frac{1}{2}$ in. thick between the walls to receive the concrete mixture. The tip of a tin funnel is cut off squarely and smoothly and the large end is flared outward slightly for a bearing. It is then soldered centrally at the large, flared end to the outer side of the bottom of the small pail as shown. A hole the same size as the diameter of the funnel's point $\frac{1}{2}$ in. from the end soldered to the bottom of the small pail—is cut centrally into the bottom of the large pail, through which passes the funnel's point, extending about $\frac{1}{2}$ in.

Three pieces of stiff tin 1 in. wide and 3 in. long are soldered by one end to the inner upper edge of the small pail and these are bent over into a hook shape and

Provide This Simple Gage for Your Saw

A SIMPLE method of duplicating the depth of saw cuts in such work as making stair-treads, etc., is here described. Get two narrow pieces of wood about



This gage insures equal depth of grooves cut

make a groove that is the same depth all the way.—J. H. MOORE.

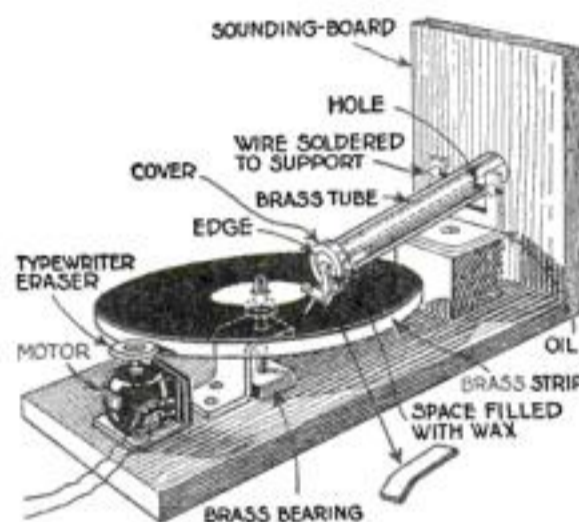
Try Making a Phonograph with an Electric Drive

HERE is a little phonograph assembled from scrap material that can be found in the average mechanic's workshop.

The details of the illustration are clear and but little description will be needed. The turntable is made of a piece of $\frac{3}{32}$ -in. brass plate.

A piece of brass ribbon $\frac{1}{8}$ in. wide is soldered all the way around the edge of the turntable. This turntable is soldered to the shaft and care will have to be taken to see that it runs true. A collar mounted on the shaft will facilitate this work. A brass bearing is screwed to the base of the phonograph and the end of the shaft revolves in this. Another angle piece is used as a bearing.

The motor is mounted on a second angle piece that brings the motor in a vertical position. The motor may be of the battery



Turning the switch will start or stop the motion of the turntable bearing the record

type or it may be a small 110-volt machine. Soldered to the shaft of the motor is a round typewriter eraser. This comes in contact with the brass ribbon that was soldered to the end of the turntable, thus providing a friction drive for the machine.

The sound-box is made next. The basis of this is the top of an old jam-jar. The center of this is cut out, leaving a small edge as shown. This edge is to prevent the round piece of mica that forms the diaphragm from slipping through. A brass strip in the shape shown presses against the center of the diaphragm and is soldered to the projecting piece below, which in turn is also soldered to the tin cover of the sound-box. A small electric binding-post is attached to the piece just soldered on and the phonograph needle is placed in this.

A brass tube about $1\frac{1}{2}$ in. in diameter and 6 in. long is attached to the sound-box just made.

It will be necessary to solder a back in the sound-box with a hole in it large enough to accommodate the brass tube. Near the opposite end of the brass tube a small hole is drilled. A wire passes through this hole and is soldered to the brass support shown in the illustration above.

This mounting allows the sound-box to travel up and down so that it will meet the natural imperfections of the brass turntable while it is revolving. The brass angle piece that supports the tube is arranged on a swivel, mounted on a block, so that it can travel toward the center of the record when it is in motion. A sounding-board mounted directly back of the brass tube completes the instrument.—W. C. ROYER.

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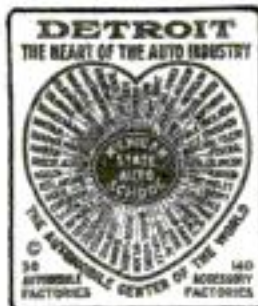
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Dear Sir:
Replying to your favor of the 25th ult., in connection with taking a course at an automobile school, we can heartily recommend to you the Michigan State Auto School of this city.

I am sure that you will find the instructions given will give you a complete basic education in motor car mechanics.

In connection with this matter, I might say that in spite of the reduced business that has prevailed during the last five or six months, the demand for first class motor car mechanics has not slackened in any way, and there is going to be an immense demand for properly trained men of this type in the next two years.

If we can give you any further information, please write us.

Yours very truly,
R. C. REICHEL, Service Manager.

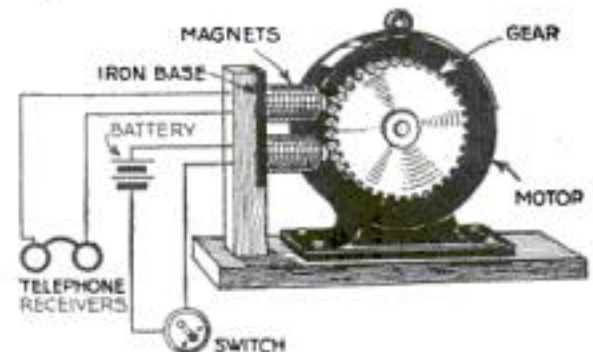
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THE HOME WORKSHOP

Small High-Frequency Generator from Old Motor

SUCH a high-frequency generator can be made from a battery motor and a small gear-wheel. The gear-wheel acts as an armature and is placed upon the shaft of the motor. Two magnets are mounted as shown. These may be ordinary door-bell magnets or they may be made especially for the machine.

One magnet is connected in series with a dry battery and a switch. If the switch



How the old motor is transformed into a small high-frequency generator

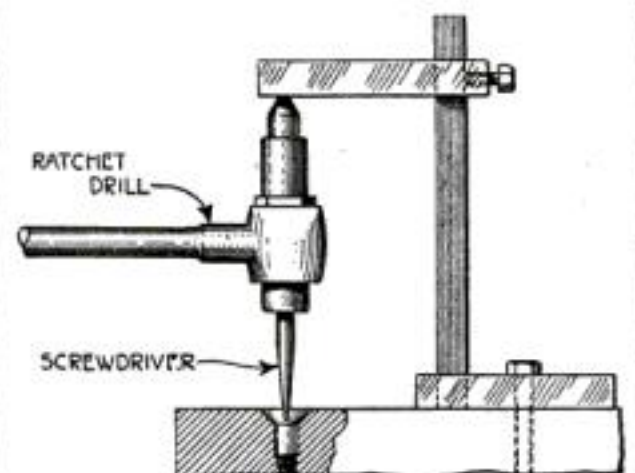
is closed and current is flowing through the one magnet while the gear-wheel is rotating, there will be set up in the other magnet an alternating current that will depend upon the speed of the gear-wheel and the number of teeth it has on its periphery.

If a pair of telephone receivers is connected to the second magnet, a distinct humming sound will be heard that can be varied by changing the speed of the motor with the rheostat. This little instrument will find a number of uses about the amateur experimenter's home electrical laboratory.—J. B. MORAN.

Describing a Way to Start Large Screws

WHEN a large slot-headed machine-screw gets stuck in place, it is an extremely difficult thing to start it, especially if the slot is worn so that it offers a poor hold for the screwdriver. The job can be done, if it can be done at all, without drilling out the screw, by using an "old man" in much the same way as it is used in drilling with a ratchet-drill.

Simply put a heavy screwdriver bit in the chuck of the ratchet-drill, place the edge in



Braced against an "old man," the ratchet-drill will start the most obstinate screw

the slot, and hold it down with the "old man" screw, which will keep it in place and allow the application of sufficient pressure to start the threads.

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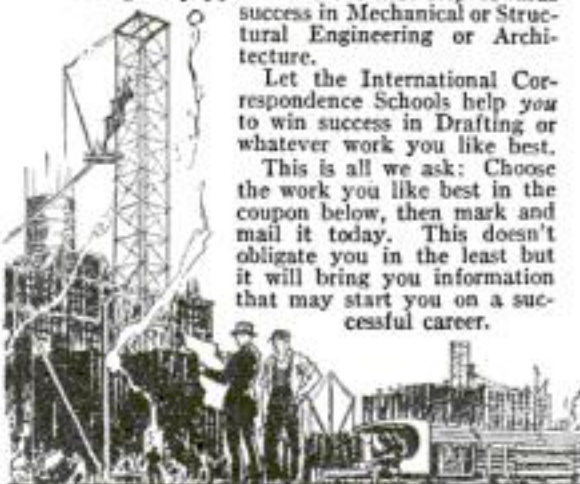
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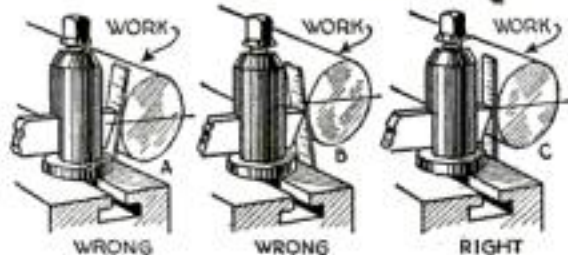
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THE HOME WORKSHOP

Placing the Tool Correctly on the Lathe

IT is a well-known fact that a lathe tool cannot cut its best unless it is dead on center, but how to judge that position is a difficult question, or at least was until I hit upon the plan shown in the illustration.

I place a scale as shown in the three views, and here is what I find. If the tool is above



There is only one correct way of placing the cutting-tool in the tool-holder of the lathe

center I get the condition at A. If below center, the condition at B, while if the tool is right on center, the scale stands vertical, as shown at C. This is a sure sign and the most engaging feature of the test is its simplicity.—J. H. MOORE.

Experimental Binding-Post for Electrical Work

WHEN doing rough experimental electrical work it is often desirable to have binding-posts that are convenient and efficient without going to the expense of buying regular posts. Such a post is easily made from a large brass wood-screw.

Turn the screw into place and cut off the head with a hacksaw. Then make two hacksaw cuts down the shank at right angles, cutting down a considerable distance.

The bared ends of wires can be forced into these slots easily, and removed as quickly, and the crossed cuts permit the use of two or even three or four wires at the same time, which is very convenient when various connections and hook-ups are being tried out.—HOWARD GREENE.

Without expense this useful binding-post may be improvised

Temporarily Repairing Scissors with Rubber Band

SOMETIMES the screw or rivet of scissors breaks off and, being case-hardened it is very difficult to remove or drill out. To have the repair made would cost almost as much as a new pair of scissors.

Wrap several small rubber bands tightly around the blades at the joint and you will be surprised how well they work with this makeshift repair. Worn or loose scissors may be tightened in this way also, and when the rubbers break, they are easily renewed.—JOSEPH N. PARKER.



Rubber bands make a good substitute for the pivot-screw of scissors

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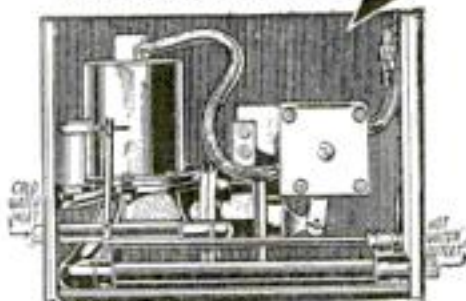
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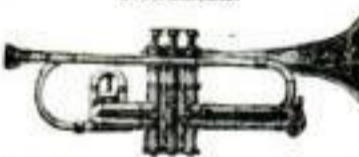
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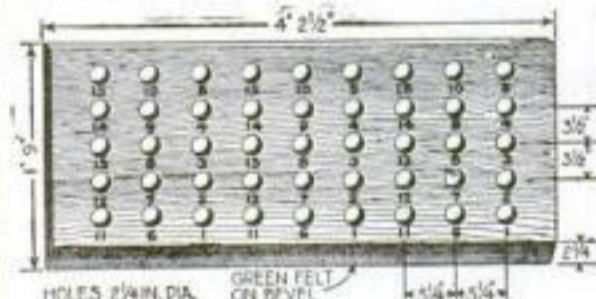
Pigeon Pool Played on Any Billiard-Table



An addition to the numerous varieties of pool is here illustrated

BILLIARD and pool enthusiasts will be glad to learn of this variation of their game, particularly when they find how simple the board is to make.

A 1/2-in. board, 2 1/4 in. long, and as wide as the table, is perforated with forty-five holes 2 1/4 in. in diameter. This board is placed at one end of the table, and kept in place by wedge-blocks. The front has a



Details showing the arrangement of the holes, their spacing, and dimension

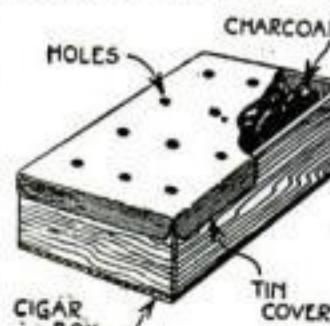
2 1/4-in. bevel edge, covered with green baize, glued on.

The game is played with fifteen balls, arranged in pyramid fashion, as in pool. The player breaks the pyramid, endeavoring to get as many balls as possible to climb that bevelled edge and settle into the holes. Should a ball drop into a hole having the same number as itself, the player wins the game. Otherwise, the player accumulating the highest score wins.

How to Keep Odors Out of the Icebox

ICEBOXES are very apt to develop disagreeable odors unless precautions are taken to eliminate them. Charcoal is a suitable substance for this purpose. On the other hand, a box of charcoal placed in the icebox does not have a good appearance.

However, the handy man may fix up a cigar box with a perforated tin cover. The fresh charcoal is placed in this and will absorb the odors. Fresh charcoal should be placed in the box every two or three weeks. The use of this little box will keep the icebox smelling sweet and clean and will also keep the taste of butter normal. Butter has a habit of absorbing odors.—W. C. ROYER.



The charcoal will absorb all icebox odors

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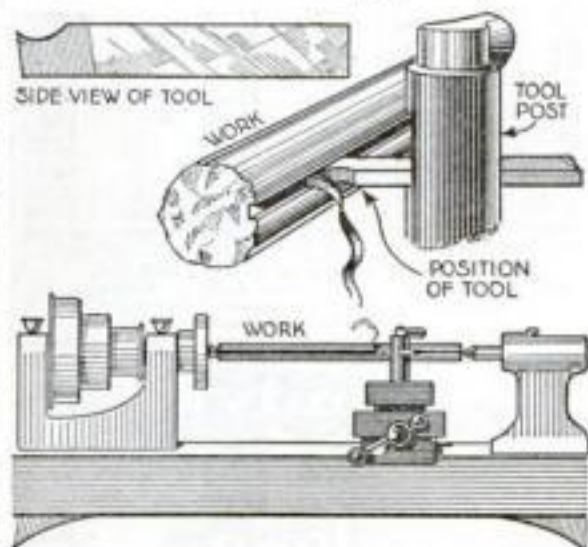


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THE HOME WORKSHOP

How to Cut Keyways on the Lathe

KEYWAYS are generally cut on a milling machine, but few amateur mechanics have access to such a machine. Keyways may be cut on an ordinary lathe if a tool is specially ground for this work. The method of grinding the tool is shown in the illustration. An ordinary parting tool is



The tool in the tool-holder, which is worked by hand, cuts the keyway, while the shaft is held between centers

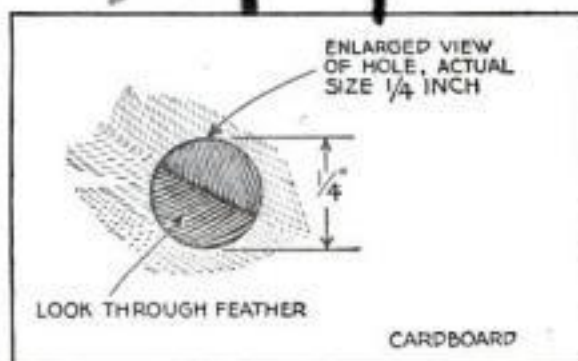
used. A lip is ground on this as shown. The tool is mounted on its side in the tool-post.

The shaft in which the keyway is to be cut is mounted between centers in the usual manner. The back gears of the lathe should be thrown in so the shaft will not be able to move. The carriage is moved to the end of the rod and the tool adjusted to take the proper cut. Only a very light cut should be taken at first. A dimple is drilled at the end of the cut so the chips drop off. This dimple must be drilled before the shaft is mounted between centers. A keyway deep enough for ordinary purposes can be made in half an hour.—GEORGE BENDER.

Splinters Are Easily Located with the Aid of a Feather

SPLINTERS and other foreign matter accidentally lodged in the fingers may be easily located by means of a feather.

First punch a hole about $\frac{1}{4}$ in. in diameter in two pieces of cardboard or thick



By looking through the barbs of the feather you can quickly locate splinters embedded in the skin

paper, insert a feather over the hole, as shown, and paste them together.

Look through the hole with one eye (the other being closed meantime), holding the affected hand some four or five inches away, according to the degree of light. The splinter can then be located without any difficulty.—GEORGE H. HOLDEN.



Accuracy

From the simplest test of memory to the most elaborate specifications, whenever an order is to be given it is the custom of the vast majority of people to put it in writing.

This constant writing of orders is for the purpose of insuring accuracy. People are afraid to trust the ability of the one receiving the order to get it correctly, unless that order is put on paper.

What a tribute to exceptional skill and training, then, is the record of the Bell telephone system. Last year more than eleven billion telephone conversations were held over the lines of this system.

Each of these billions of con-

versations required the giving of an order to a telephone employee. Not one of these orders could be put in writing.

Some of them were given in loud voices, some spoken in murmurs, some clearly stated, some rapidly shot out. Yet so remarkable a standard of accuracy exists in the service of the Bell System that more than ninety-nine per cent. of all such orders were correctly received and executed.

No other business is subjected to such a test as this. The record of the average of service of the Bell System for the last few months is proof that the telephone has returned to its pre-war standard of practice.



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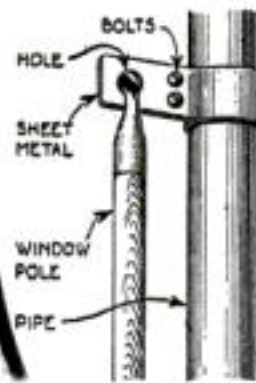


THE HOME WORKSHOP

Providing a Holder for the Window-Stick

THE peculiar shape of the hook on the end of a window-stick will not allow of its being hung up on a nail in the usual way. It is bound to slip off at some time.

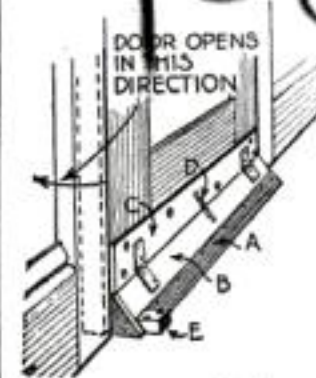
With the strip of metal bound around the steam pipe as shown and provided with a hole, a very effective holder for the window-stick can be made. Two brass bolts can be used to bind the strips about the steam pipe or screws may be employed.



A way to dispose of the window-pole

Keep Cold Air from Coming in Under the Door

PROVIDENT housekeepers will prepare in the autumn for the coming winter by giving their attention to measures for protecting their home from the cold. The space between the threshold and the outside door admits



This flap will keep out cold and drafts

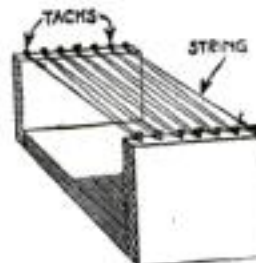
much cold air, which lowers the temperature and increases the coal-bill in a startling way. The weather-strip described as follows is very efficient in guarding against this.

A thin piece of wood as long as the width of the door, has a thick piece of rubber tacked to it. Another board of the same size is then hinged to the wood. One of the strips of the completed weather-strip is then screwed to the door and a small piece of wood is so fixed that when the door is closed, the other strip, raised from the floor by a spring, is pressed tightly down against the floor, leaving not the slightest possible entrance for cold air. In this picture, A is the rubber, B the flap, C the flap-support and D is the spring.

How a Simple Comb-Cleaner Can Be Made

BY following out the suggestions in the picture, a good comb cleaner can be made very easily. The end pieces of the wooden frame are provided with a number of tacks and heavy grease cord is run back and forth around the tacks and pulled tight.

These strings are pressed into the teeth of the comb and the comb run back and forth rapidly. This will clean a comb within a very few minutes and is much better than the method of using one string.—J. B. MORAN.



Here is a practical comb-cleaner

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No. 6 gal.	12 1-4 in.	15 1-2 in.	8.50
No. 8 gal.	13 1-4 in.	17 in.	9.50
No. 10 gal.	14 1-4 in.	18 in.	12.00
No. 15 gal.	14 1-4 in.	22 in.	15.00
No. 20 gal.	18 1-2 in.	24 in.	20.00
No. 25 gal.	19 1-8 in.	26 in.	25.00
No. 30 gal.	20 in.	30 in.	30.00
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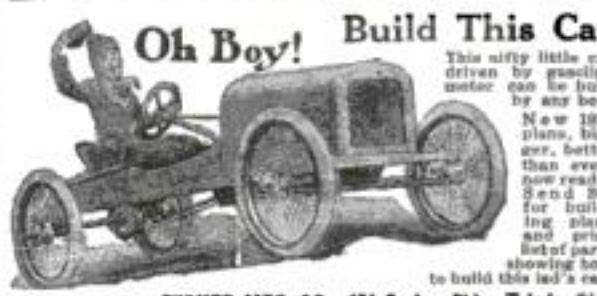


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THE HOME WORKSHOP

Fun for the Children with This Vehicle

THE illustration below represents a barrelmobile for children to play with. It consists of old automobile shoes driven on both ends of a barrel, boards, 6 in. longer than the diameter of the head nailed to the head and extending 3 in. beyond the edge of the barrel to keep the shoes on and to reinforce the head.

A hole is bored in the center of each barrel-head and a 3/4 in. pipe-axle inserted. It should extend 6 in. beyond each end. A suitable frame is mortised and nailed together around the barrel, the axle extending through the frame with washers and pins



Barrelmobile is an appropriate name for this vehicle, which will give much pleasure to the children.

at their ends. Old wagon-wheel felloe sections are used to arch the barrel. They are fastened to braces and support a board seat on top.

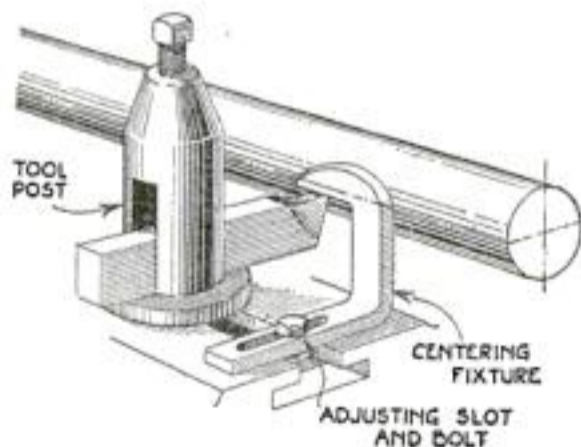
Strap-iron clevises join the tongue, which is made of the handle of an old lawnmower. The shoes make riding easy.

Setting the Lathe-Tool in the Right Position

EVERY machinist knows that in setting a lathe-tool there is one certain height at which it works best. The big problem is to find that height.

Here is a very simple method of insuring the tools always being set right.

Make a bracket as shown, which rests on the toolpost. Have the height from



For setting a lathe-tool to a predetermined height use a simple adjustable centering fixture like this

the surface to the gaging point the correct distance, viz., just below the center of the work. Once having made the bracket, you are sure of quick tool setting.

The slot and bolt make the gage adjustable in and out, and after setting the tool, slacken off the bolt and swing the gage out of the way.—J. H. MOORE.

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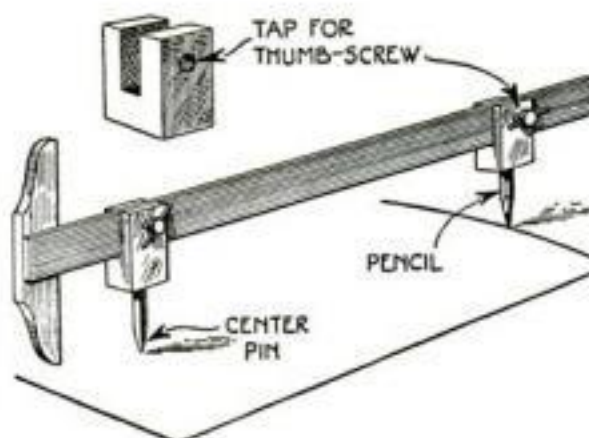
THE HOME WORKSHOP

Why Buy a Beam Compass if You Can Make One?

BEAM compasses for drawing large circles are expensive. But if you have a long T-square, you can easily improvise a beam compass with practically no expense.

Cut two small wooden blocks and saw into each a slot fitting snugly over the blade of the T-square. Small thumb screws, threaded through one side of each block, will hold the blocks in position.

One of the blocks is provided with a



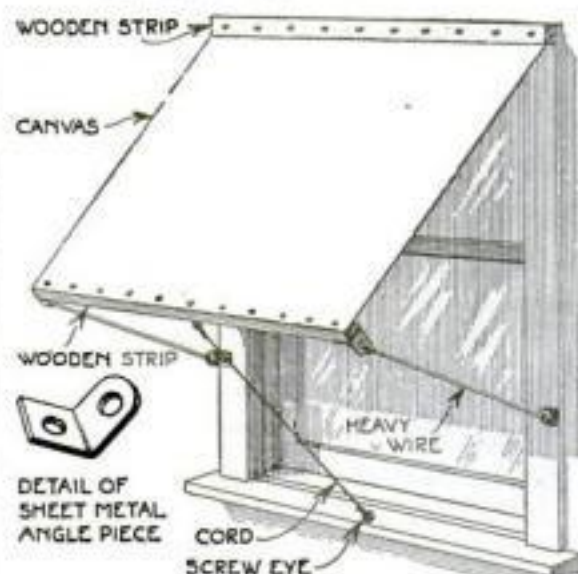
How you can change a T-square or ruler into a serviceable beam-compass

needle-point, the other with a pencil. The diameter of the circle you can draw with this compass is limited only by the length of the T-square blade.—J. H. MOORE.

This Homemade Awning Is Very Inexpensive

YOU can easily make a satisfactory awning for any window from a single strip of canvas nailed as shown to two wooden strips. One of them is fastened to the top of the window-casing.

Little sheet-metal angle pieces are cut out and drilled. Two of these are tacked



If carefully made and from good material, this awning will weather many a storm

to the end of one of the wooden strips and the other two to the window-frame. Two pieces of heavy wire fit into their holes.

A screw-eye is placed in the center of the free strip and another at the bottom of the window-frame. A piece of string is placed through the eyes and pulled tight. This holds the awning out.—W. C. ROYER.

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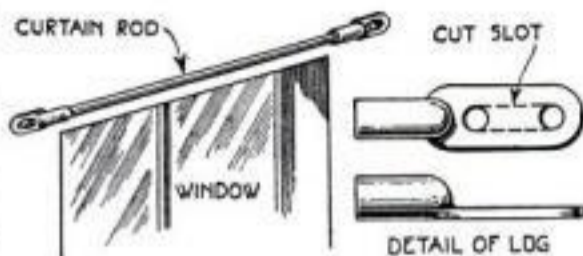


THE HOME WORKSHOP

Curtain-Rod Supports Made from Lugs

COPPER lugs make neat supports for curtain-rods when polished and given a coat of lacquer to prevent the copper from tarnishing.

Procure two lugs of the two-hole type as shown in the illustration. Cut a slot and



Copper lugs may be used as shown above for supporting the ends of curtain-rods

bend as shown. These supports can also be made from brass or copper tubing by flattening one end with a hammer.

The curtain-rod can be removed by loosening the screws in the wall a turn or two and sliding out the lugs.

Making a Candlestick from an Old Pipe

FIRST, two boards are nailed together to form an angle piece. The boards can be stained to approximately match the color of the pipe. A hole is cut in the center of



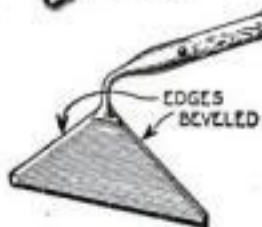
An old briar-pipe candlestick

the upright board just large enough so that the stem of the pipe can be forced in. In case of a curved-stemmed pipe this will bring the bowl into an upright position.

If the candle is to be carried about, the holder is provided with a tin handle. This holder can also be screwed to the wall.—L. LAURIER.

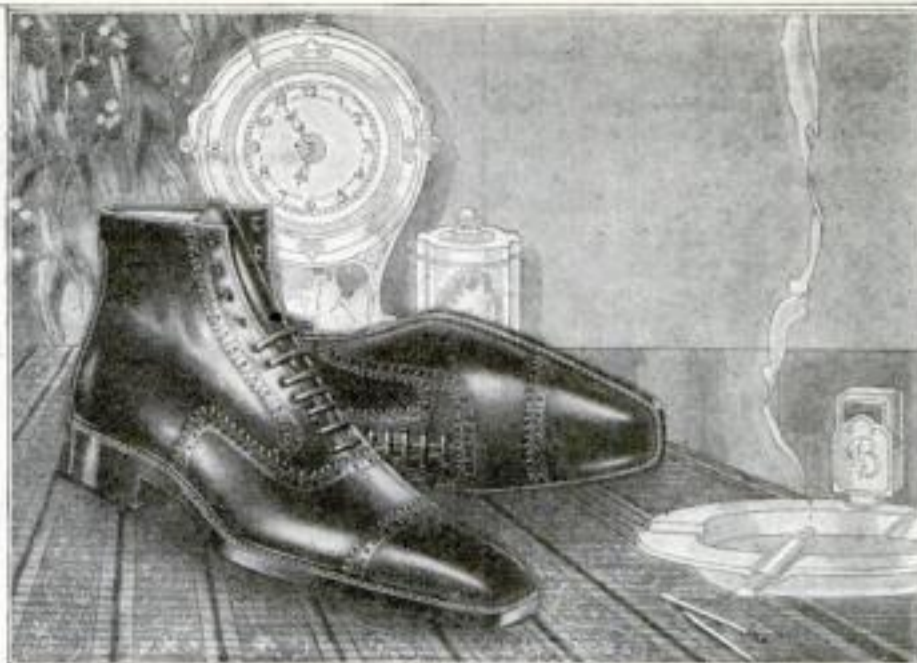
An Old Hoe Acquires a New Shape

SIMPLE but very handy is this garden tool made in a few minutes from an ordinary garden hoe. With a cold chisel



cut the hoe as shown in the illustration.

This gives a lighter hoe, and one that will scour much better and, best of all, it will reach between hills of vegetables, cutting weeds that the ordinary hoe will not reach. Be sure to sharpen the upper edges.—R. W. JAMISON.



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Weldene Hard

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Weldene Aluminum

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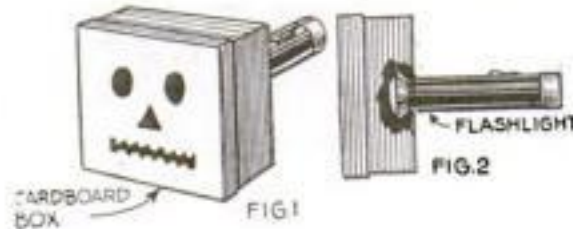
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THE HOME WORKSHOP

Electric Jack o'Lanterns for Hallowe'en

ELECTRICALLY lighted Jack o'Lanterns for Hallowe'en are an attractive novelty for the young folks. These lanterns may be darkened and lighted at will and very suddenly, a thing impossible with the old candle type. Here is a simple method by which out of a small square



Hallowe'en is coming! Here is a suggestion for an attractive and startling Jack o'Lantern

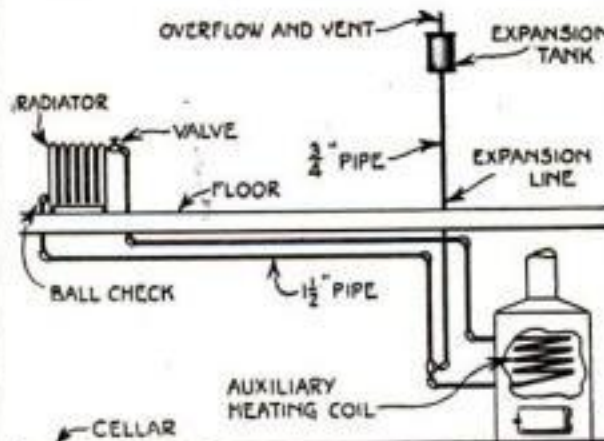
cardboard box and a tubular flashlight, an electric Jack o'Lantern may be made.

The illustration shows the device complete, also its construction. The face is first cut in the cover of the box. Then in the bottom of the box a circular hole is cut, just large enough to tightly admit the long tube of the flashlight. Now put the flashlight in through this hole as far as it will go, leaving the bull's-eye lens in the box as shown. Now put on the cover of the box and the lantern is ready for use. The flashlight serves as a handle for the lantern and also provides a very convenient switch for the light.—PHILIP A. WALL.

How to Obtain More Heat from Coal

HOT-AIR furnaces are sometimes inadequate to supply comfortable heat to all parts of the house. Distant bedrooms or bathrooms are often too cold for comfort.

The accompanying illustration shows how this defect may be remedied without increasing the capacity of the furnace or the consumption of coal. An expansion tank is installed in the attic. An auxiliary coil is placed in the firebox of the furnace, and the steam generated from the water in



An effective and economical method of increasing the heating power of the furnace

the coil is conducted by pipes to registers in the bedrooms or bathrooms to be heated.

Return pipes must be provided leading back to the coil in the furnace. If care is taken that there is always water in the pipes, there will be no danger of burning out the coils in the firebox. A radiator such as this, of fair size, was sufficient to heat an enclosed porch comfortably throughout the winter without additional expense for coal.—R. NEWBECKER.

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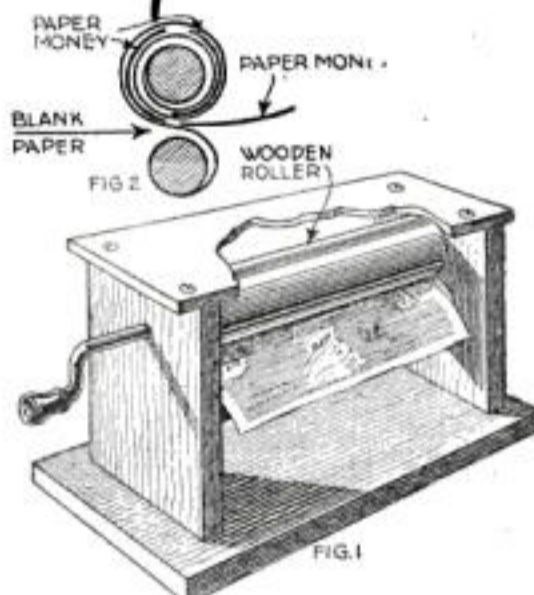
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This Magician's Trick Will Manufacture Paper Money

TWO wooden rollers are mounted in a simple frame as shown. This is arranged so that they fit snugly together and so that the lower roller will turn when the top one is turned by the crank. A long piece of white paper is rolled around the top cylinder.

At regular intervals new dollar-bills are placed and rolled up on the top roller with

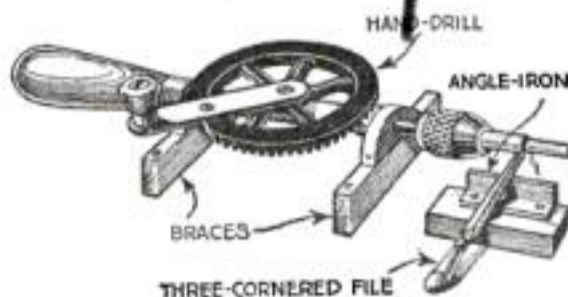


You get your money's worth of dollar-bills and much fun out of this magic printing-press

the paper. The free end of the paper is then turned once around the lower roller. If a blank piece of paper about the size of a dollar is placed between the rollers as shown by the pointed arrow, it will turn around with the bottom roller and be covered up with paper. At the same time a dollar bill will be issued from between the rollers on the opposite side and it will appear as if the blank piece of paper had been printed.—W. C. ROYER.

How to Turn Metal with a Hand-Drill

AMATEUR mechanics are often confronted with the necessity of turning a small piece of metal. This is a hard nut to crack for those who are not fortunate enough to have a lathe in their possession. Small pieces of metal that are not beyond the capacity of the chuck on a small hand-



Arranged in this manner your hand-drill becomes a small, handpower-driven lathe

drill may be turned by mounting the drill between two clamps as shown. A little slide-rest is put together with a block and a piece of angle metal. A three-cornered file is ground off at the end and used to trim the metal.

The cutting edge of the file is held against the metal while the handle of the drill is turned.—L. LAURIER.



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A Useful Drying Cabinet for Lacquered Work

THIS little drying cabinet is very useful for drying lacquered orenameled pieces. It is made from an old packing-box. An electric-light bulb of 40-watt capacity is placed in it. It is safe to line the box with asbestos to prevent possible fire.

A shelf made with pieces of heavy wire is also put in place to hold the articles. Ventilator holes are placed in the side and in the door.—GEORGE BENDER.



This drying cabinet may be used for other purposes

Try This Simple Method for Case-Hardening

IF a mechanic wishes to put a very thin layer of case-hardening on a small object, he may do so in the following way.

An iron can is filled with charcoal and salt. The work is embedded in this and the flame of a blow-torch is brought to play upon it.

The piece is heated to a dull redness and after about half an hour of exposure to the flame the article is turned over and another half hour of heating is gone through. This will leave a very thin film of hardened metal on the surface. The usual process of case-hardening allows a greater penetration of the carbon.



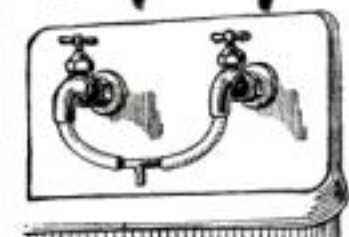
Only small articles can be case-hardened in this manner

Tempering the Water as It Flows from the Faucets

THE quickest and most efficient method of washing dishes is under a steady stream of water regulated to the proper temperature. This may be accomplished by the simple device here described.

It consists of a T-shaped connecting piece of glass or metal and two pieces of rubber tubing, each about 7 or 8 in. long and 3/8 in. in diameter. One of these tubes is slipped over each of the two ends of the top part of the T.

When you wish to obtain water which is warm but not scalding, push into each of the faucets the free end of one of the tubes. Then turn on both faucets. The hot and the cold water from the two faucets will become mixed in the connecting tube and the tempered water will stream from the vertical end of the T. By adjusting the flow of water from the faucets a steady stream of water of any desired temperature may be obtained.—B. FOX.



A very useful household idea

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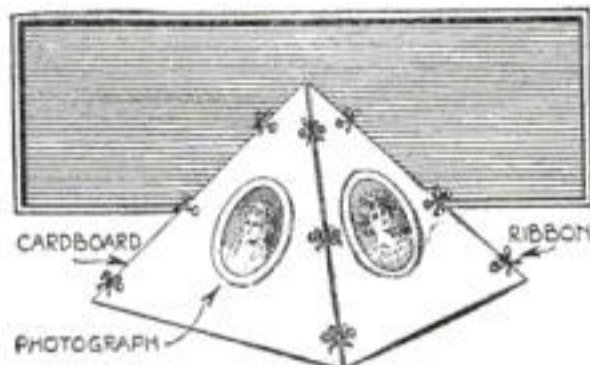
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THE HOME WORKSHOP

Novel Picture-Holder in the Form of a Pyramid

FROM four pieces of cardboard an attractive little photograph-holder may be made. Four triangular pieces of the same size are cut out from heavy cardboard. Three holes are punched along each edge of these pieces so that their edges will correspond when they are brought together. The four pieces are laced together with ribbon which is tied in bows.

The holes for the photographs are cut before lacing. The sides are then covered



This picture-holder would make a pretty present for your friends. Try to make it

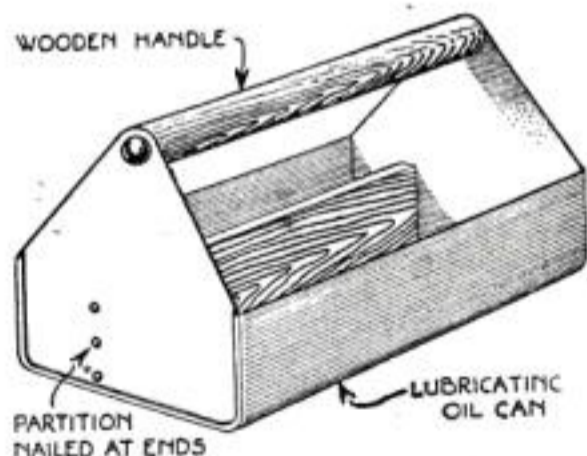
with a water-color preparation of any color the maker desires. The photographs are held in place by backing them up with pieces of cardboard glued into position.

Do you make things for the home? Then read the announcement of the Home Workshop prize contest on page 87.

Serviceable Tool-Kit Made from an Oilcan

A SQUARE oilcan of five gallons capacity, such as is used as a container of lubricating oil, can readily be converted into the tool-kit shown in the illustration. This kit will hold the numerous tools used in automobile repair or is equally serviceable for the average tool equipment about the house and private garage.

To make this kit, a wooden handle is se-



Illustrating an excellent use for an empty square lubricating-oil can

cured about an inch and a half in diameter and this is cut the length of the can. The tin is best cut with tinner's shears and beveled at the ends.

Enough material is left at the edges to turn over into a sort of beading to avoid any sharp edges. Two round-head screws are used to secure the handle to the ends of the container. If desired, one small strip lengthwise of the kit separates it into two compartments and segregates the tools from the screws, bolts, etc.—G. A. LUERS.

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Build Your Own Refrigerating Plant

By M. W. Potts

Winner of the First Prize in the "New Uses for Old Things" Competition

IN passing a junk-yard one day the writer happened to notice an old one-cylinder motorcycle engine lying in the pile. The writer immediately began to wonder what possible use he could put it to. It could be used for an air compressor, but what could one do with the air?

Why not use it as a compressor for a small refrigerating plant?

A dollar bought the engine and another fifty cents hauled it up to the house. The carburetor and all superfluous parts were taken off and junked. Then the spark-plug was taken out and a check-valve put in.

This check-valve can be made up by any handy man; it simply consists of a ball-bearing with the proper seating.

The engine was then blocked up on the cellar floor in a suitable place. It was bolted down securely and better to a small 1/4-hp. electric motor, which was also placed upon a block and bolted down. This part of the plant was placed in the cellar directly under the icebox and a very short connection was used between the coils in the icebox and the compressor.

Next it was necessary to go to a local supply house and obtain about 60 ft. of copper tubing similar to that employed in the lubricating system of automobiles. A coil about 8 in. in diameter was then made with this tubing. This coil contained about 20 ft. of tubing and it was placed in an old water-pail as shown. This water-pail was in turn placed on top of the icebox and covered so as not to be unsightly.

The pail is kept full of water from the

water supply and an overflow is arranged to discharge into the sink. Another coil was made with about 35 ft. of copper tubing to fit inside an old wash-boiler, which is placed in the ice-chamber of the icebox. This is the expansion chamber and it will

be necessary to keep it filled with water, which will become extremely cold when the system is in operation. A needle-valve, which can be purchased at a hardware store, is placed between the cooler and the expansion coil. The copper tubing leads from the expansion coil back to the compressor.

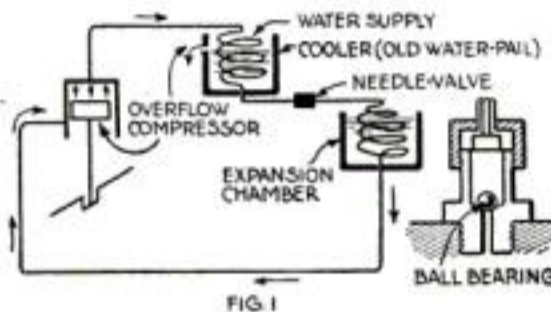


FIG. 1
This illustrates the plan of the home-made refrigerating plant operated by a motorcycle engine

To operate the system it will be necessary to obtain a cylinder of liquid sulphur dioxide from some chemical supply house. This will cost very little and, if the joints in the system are gastight, it will last a considerable time.

When the gas is placed in the compressor through the spark-plug hole, a very good gastight connection must be established through the use of a small length of copper tubing arranged with couplings at each end. The cylinders in which the gas is supplied come with a valve attached to their ends and after the connection is made with the compressor, this valve can be opened and the gas allowed to run into the cylinder. It will immediately evaporate and take its place throughout the entire system. When the compressor is put in operation it liquefies the gas by means of the cooler. The gas again expands when it reaches the expansion chamber. It is here that the cold is produced.

Changing Pipe Tongs to a Small Pipe Vise

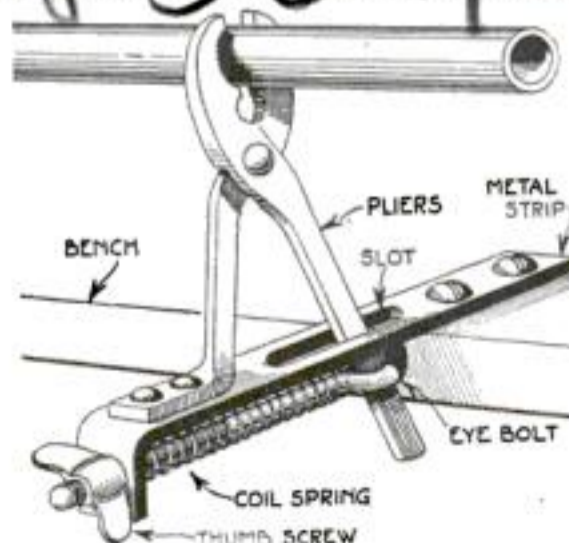
OLD pipe tongs and a few odds and ends are all the materials required for making a pipe vise that will render very efficient and satisfactory service in holding pipe and rod of all sizes within its capacity. Should the joint of the tongs be worn and loose, it will add to the excellence of the finished tool if it is tightened, which is best done by taking out the old rivet and putting in a new one, after redrilling or reaming the holes. The dimensions of the parts will depend upon the size of the tongs used.

For the base use a plate of cold-rolled steel about 3/16 in. thick; a thinner plate is apt to make the vise too springy. Rivet one handle of the tongs to the plate with rivets as large as can

be used without too much weakening of the handle. To do this the handle must be heated, flattened somewhat, and bent as shown in the illustration. Keep a wet rag around the jaws to prevent the temper from being drawn while heating. The other handle projects through a slot in the plate.

Heat the plate and bend it as shown, at right angles, and drill it for an eye-bolt to pass through easily. The eye of the bolt is slipped on the projecting handle and a thumb-nut is put on the thread. A spiral spring on the bolt will keep the vise at as wide an opening as the position of the thumb-nut permits.

Leave the plate long enough to be screwed either to the edge of the bench or to a block.



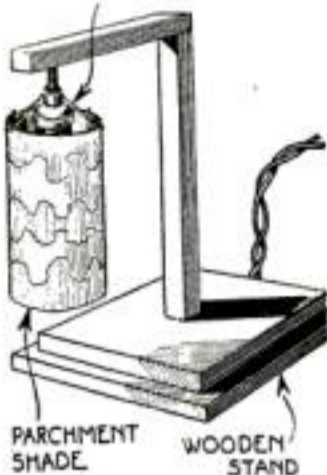
An extremely useful addition to the workbench of any workshop where pipes and rods are frequently handled

THE HOME WORKSHOP

A Homemade Reading-Lamp
for the Living-Room

THIS little reading-lamp can be put together at small cost and will give good service. It has an artistic appearance that will give it a place in the living-room of any home. The stand is very simple and may be

WIRE FRAME



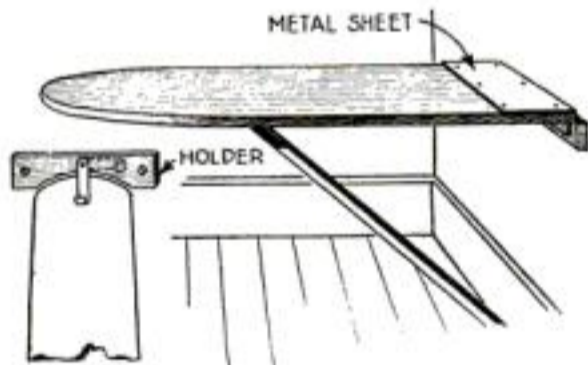
PARCHMENT SHADE WOODEN STAND

Only a few tools are required for making this lamp

A small wire frame is attached to the top of the shade.—W. C. ROYER.

Just the Ironing-Board for
the Small Flat

SHOWN here is an ironing-board that can be fastened against the wall and is out of the way when not in use. It should be made of well-seasoned 1 or 1 1/4 in. material. A board of convenient size can be made by the following dimensions: 4 ft. 8 in.



Where space is at a premium, as in small apartments, an ironing-board hinged to the wall is convenient.

long, 15 in. wide at the attached end, and 8 in. at the free end. About 2 ft. from the attached end the board begins to taper gradually. The free end is rounded.

A strip 1 1/4 by 4 by 15 in. is securely fastened by screws to the wall at a convenient height. The height at which the board is placed varies with the height of the user. The board is hinged to the wall strip with two No. 3 butt hinges.

The leg or brace, made of material 1 in. thick and 4 in. wide, is fastened with a No. 3 butt hinge to a board strip 1 by 4 by 8 in. The board strip is screwed to the under side of the board 11 in. from the free end. The length of the brace depends upon the height of the board, and when the board is in position the brace rests against the baseboard of the wall. Skirts may be easily ironed without changing the position of the brace. A piece of galvanized iron may be tacked to the board, on which the hot iron may rest when not being used.

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33x4	7.95	2.50
34x4	8.20	2.60
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36x4 1/2	10.95	3.40
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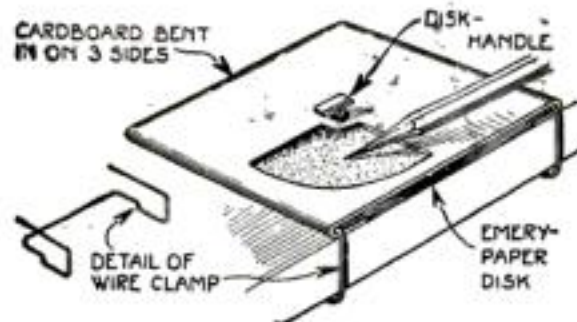
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THE HOME WORKSHOP

Two Pencil-Sharpeners for the Drafting-Rooms

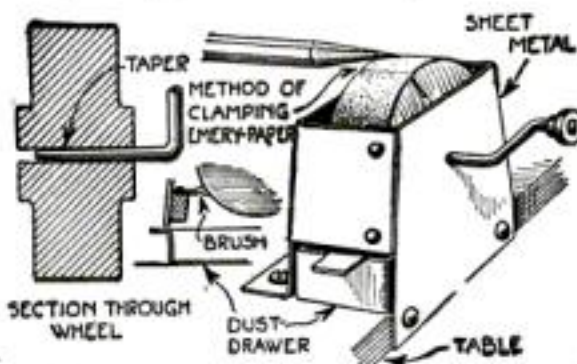
ONE of the illustrations shows a simple device for pointing drafting-pencils. Clamped to a drawing-board corner, it requires the use of only one hand. Drawings



This type of pencil-sharpener is clamped to the drawing-board or drafting table

are protected from the disk of emery-paper by a thick cardboard casing. Turning the disk exposes a fresh surface. A new disk may be quickly inserted. A piece of wire forms the clamp, while a strip of tin or a paper-fastener snugly holds the disk to its casing.

A rotary pencil pointer is shown in the other illustration. It may be screwed to a shelf, table, or board. The picture shows

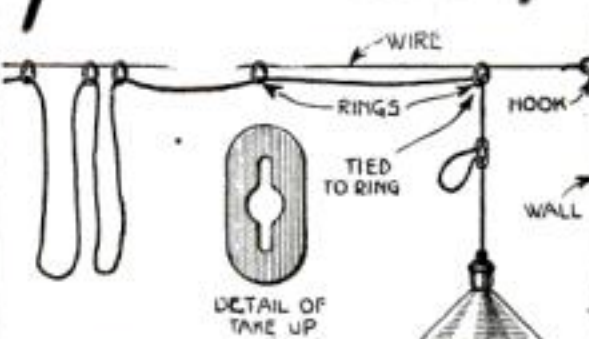


For more rapid and efficient work this rotatory pencil-sharpener is probably preferable

the sheet-metal casing and the brush, which cleans the emery-paper. There is also shown the wooden wheel and the method of fastening the paper strips.—E. R. SMITH.

A Movable Droplight Can Be Easily Made

IN order to make a convenient movable light, stretch a wire taut between walls. String on the wire enough glass rings to allow about 4 ft. between each, then run the electric drop-cord through these rings and stretch out full length, spacing the



Useful principally in stockrooms where the light is needed in different places

rings evenly, taping them to the cord at intervals. This will allow the light to be at any place wanted along the line without waste of time in reeling and unreeling the surplus wire, which can be raised or lowered by means of a take-up as shown in the diagram.—J. ALEXANDER.

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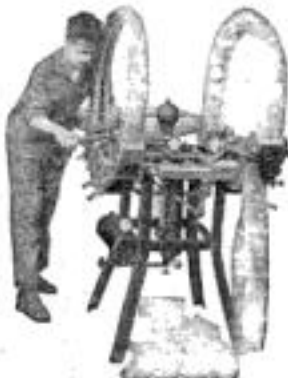
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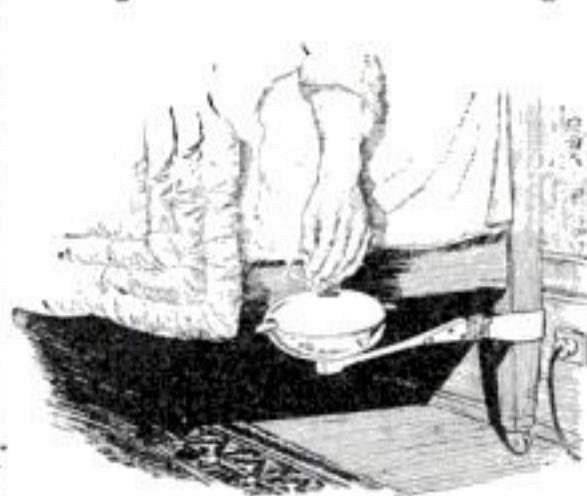
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THE HOME WORKSHOP

If You Must Smoke in Bed, Use This Tray

SMOKING in bed is not considered good form except in the case of habitual smokers confined to bed during convalescence. It is objected to principally on account of the risk of fire, damage to the bedclothes, and possible danger to the occupant of the bed.

This risk and danger may be greatly diminished by providing a covered ash-tray with cigar-rests and a removable glass

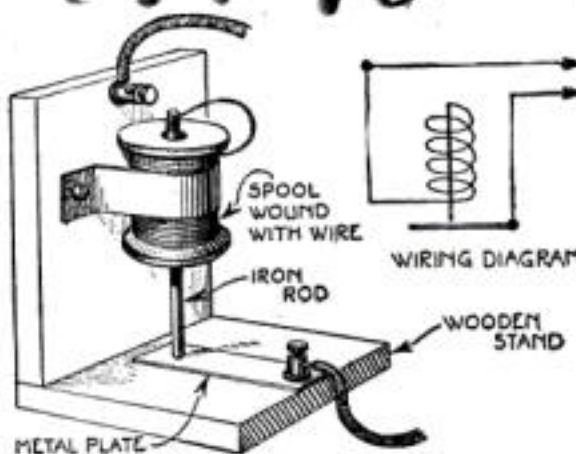


If you smoke in bed use an ash-tray like that described here

bowl as shown in the illustration. The metal tray is attached to one of the head-posts of the bed by a hinged arm and a clamp so that, when not in use, it may be swung under the bed.—W. A. JACKSON.

Circuit-Breaker for the Home Electrical Laboratory

FIRST a wooden spool is wound with magnet wire. The amount of wire used and its size will depend upon the use for which the circuit-breaker is intended and



Should the current become too strong, this circuit-breaker will automatically interrupt the connection

the amount of current it consumes. A circuit-breaker can be made for light or heavy currents. For heavy currents the wire used should be large and for lighter currents it should be smaller.

The spool is mounted on a wooden stand and a little metal plate is placed at the bottom of the stand. A small iron rod extends through the center of the spool and makes contact with the metal plate. One end of the winding of the spool is connected with the metal rod and the other with a binding-post at the top of the stand. The diagram of connections is given. When too much current is flowing through the device, the magnetic force will draw the iron rod up into the center of the spool and the circuit will be broken.—W. C. ROYER.

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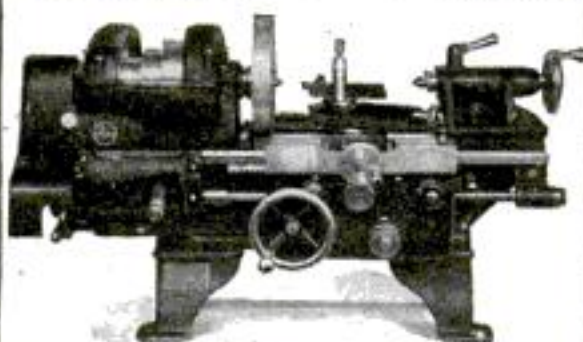
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225 West 39th Street New York City

What New Uses for Electricity Have You Found?

Have you found a new way of making the electric current work for you? Have you made a new labor-saving or money-saving machine or device that is electrically operated? Popular Science Monthly will pay \$90 in prizes for the best answers

THIS contest was announced in our last issue, but over a month still remains in which readers of Popular Science Monthly may submit ideas in competition for the prizes totalling \$90. The competition is distinct from the standing offer of \$75 for Home Workshop ideas, described on page 87.

Your new machine or device does not need to be motor driven, although there is no objection to a motor-driven machine, provided it is new and useful. It must, however, be homemade. Electric magnets, solenoids, or heaters may be employed.

Popular Science Monthly offers three prizes for the best answers—a first prize of \$50, a second of \$25, and a third of \$15. These will be awarded in accordance with the rules outlined below.

Rules Governing the Contest

(1) Contestants are not limited to the number of ideas, but only one method can possibly win the first prize, only one the second, and only one the third. The contest is open to everybody.

(2) The use of the new electrical appliance must be shown clearly, either in a photograph or in a drawing. If a drawing is sent in, it need not be made by a skilled draftsman. It is sufficient that it should be intelligible. While pencil sketches will be considered, contestants are requested to make their drawings in ink on heavy white paper. The views should be sufficient in number to set forth the writer's idea very clearly. The contestant's name and address should appear on each sheet of drawings.

(3) The drawings or photographs must be accompanied by a description, preferably typewritten, in which the method is clearly given. It must be written on one side of the paper only, and it should not be more than 500 words in length. The name and address of the contestant should appear in the upper left-hand corner of the first sheet of the written description.

(4) The drawings and description entered by contestants must be received by Popular Science Monthly not later than 5 p. m., on Oct. 20, 1921.

(5) The judges of the contest will be the editors of Popular Science Monthly.

(6) The first prize of \$50 will be awarded to the contestant who, in the opinion of the judges, has suggested the best idea of a new use for electricity.

The second prize of \$25 will be paid to the contestant who submits an idea next in merit.

The third prize of \$15 will be paid to the contestant who submits an idea third in merit.

(7) The winners of the contest will be announced in the earliest possible issue of Popular Science Monthly. A description of the ideas that win the three prizes offered will duly appear in the pages of Popular Science Monthly, together with the names of the winners.

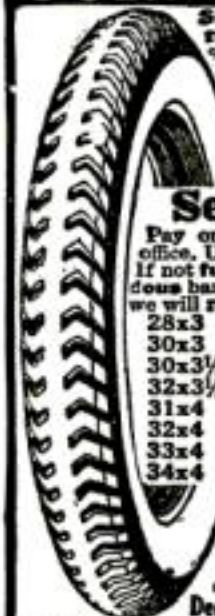
(8) The editors of Popular Science Monthly shall have the right to publish meritorious manuscripts that do not win a prize. The regular space rates will be paid to the contestants who submit the manuscripts thus selected.

(9) When a contestant submits more than one idea, the description and drawing by which each is set forth must be sent as a separate unit.

(10) Manuscripts or drawings will be returned to contestants if stamps are enclosed.

(11) Send drawings and specifications to the Editor of the New Uses for Electricity Contest, Popular Science Monthly, 225 West 39th Street, New York City.

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31x4	10.50	36x4 1/2	14.50
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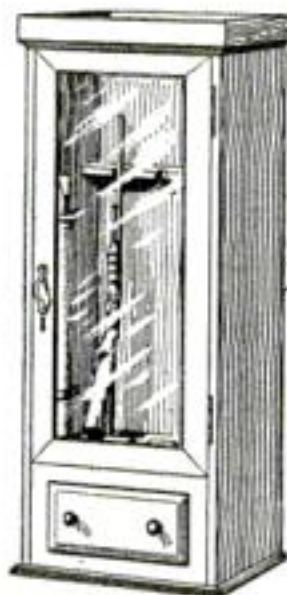
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THE HOME WORKSHOP

How to Build an Attractive Gun Cabinet

A GUN cabinet made of choice hard wood or yellow pine after the design given here will add much to the attractiveness of your den. The illustration shows the proportions and appearance of the completed case. All stock is 1/2 in. thick. Plain molding, rabbetted for glass, will do



DETAIL OF
DRAWER-PANEL
FINISH WITH
3 COATS OF VARNISH

FISH-ROD CLIPS



DRAWER-SLIDE

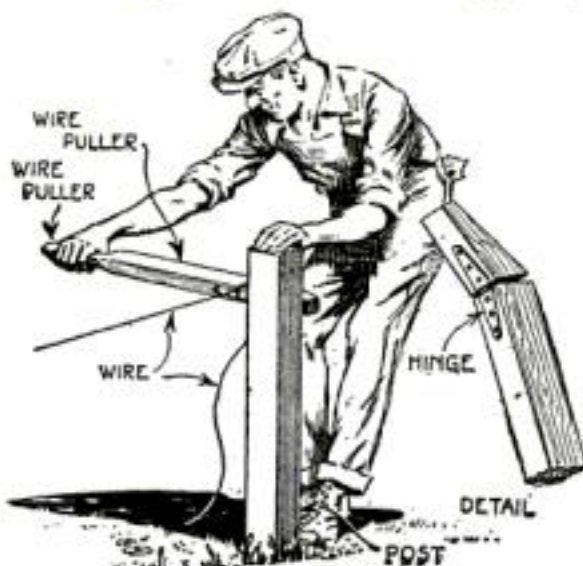
This cabinet enables sportsmen to take good care of their guns and rods

for the door. One view shows the construction of the slide drawer and the face piece into which it fits. The small upright compartments on each side may be used for boxes of cartridges. If yellow pine is used, a suitable finish will be three coats of varnish, the first thinned with three quarters turpentine, the second with one half turpentine and the last a full strength coat. If you use stain, put it on after the first coat of varnish.

Stretching Wire with a Homemade Tool

BELOW is shown a simple homemade wire-stretcher of two pieces, which form a lever by being connected with a strap hinge.

A piece of strong wood 2 by 2 in. by 4 ft. is used for the handle; another 2 by 2 by



Little skill is required for making one of these effective wire-stretchers

8 in. for the short part. Each part is metal-capped at the juncture.

The wire is caught between the two sections and with the short part braced against the post, the lever end draws the wire taut.—CHARLES A. BLACK, JR.

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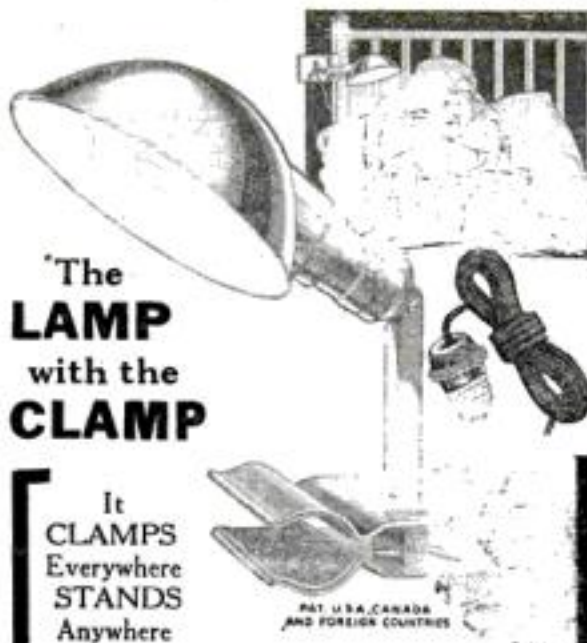
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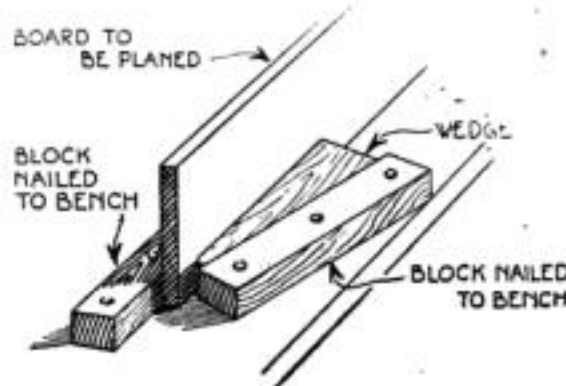
THE HOME WORKSHOP

Vise Easily Made from Wooden Blocks

WITHOUT a vise it is difficult to plane down or otherwise work on a long strip of wood. A simple, but exceedingly effective, vise for holding the strip of wood to be planed can be readily made from a few small wooden blocks.

One of the blocks may be roughly cut in wedge-shaped form and the two other blocks are merely straight strips. The two straight blocks are nailed securely to the face of a bench or other support, one block being nailed at an angle to the other.

The board or strip to be planed or otherwise worked on is placed between the two

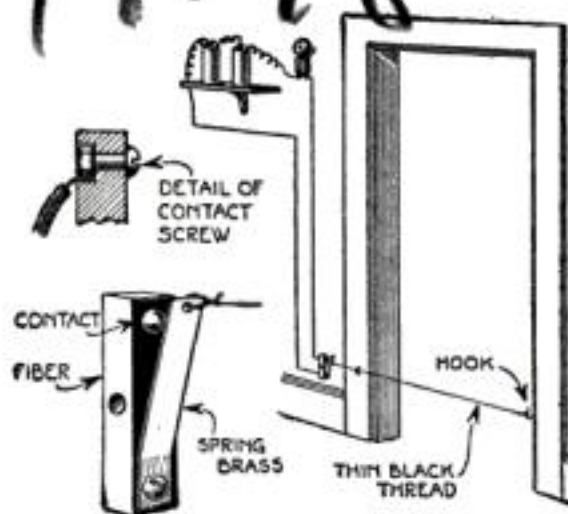


This block-and-wedge clamp holds boards as firmly as a bench-vise

blocks and the wedge-shaped block is driven in between the board or strip and the block nailed at an angle as shown. The strip is thus firmly held in place and can be planed in either direction without becoming dislodged.—HARRY G. SCHULTZ.

No Burglar Will Suspect This Trap

IF the house is equipped with the burglar-alarm here described and illustrated, the doors can be left open with perfect safety. A piece of thin black thread is stretched



At night even the keenest pair of eyes could never detect this burglar-trap

across the doorway and any one entering the house will break the thread. This will allow a metal strip to come in contact with a brass screw which closes an electric circuit and causes the bell to ring.

During the day, when the device is not in use, a small switch is used to break the circuit. At night it is necessary only to stretch the thread across the door and attach it to a hook.—W. C. ROYER.



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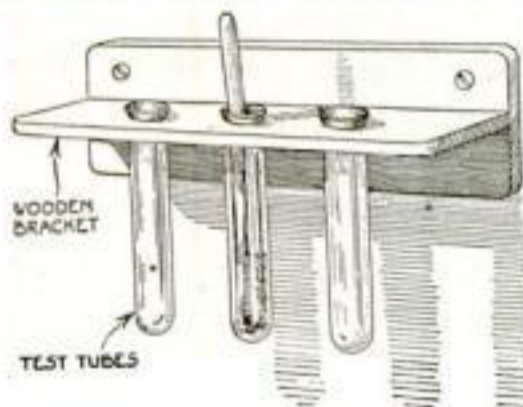
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THE HOME WORKSHOP

Test-Tubes Are Sanitary Tooth-Brush Holders

A GOOD sanitary tooth-brush holder can be made of test-tubes. A simple wall fixture made of wood with holes in it

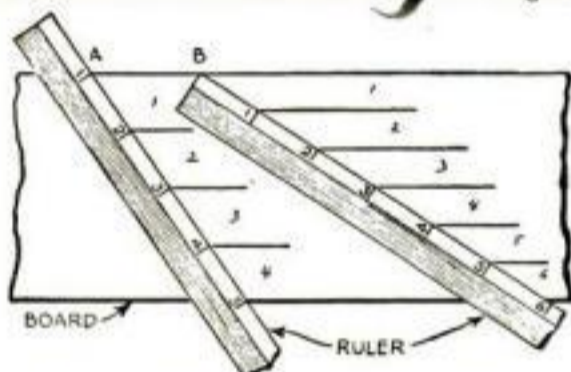


Removable test-tubes are more sanitary than fixed toothbrush-holders because they are easily cleaned

to accommodate the tubes is constructed as shown. The tooth-brushes are placed in the tubes and this keeps them from getting dusty. The test-tubes may be obtained from any drug-store. The holder may be enameled white.—J. B. MORAN.

Making Equal Divisions with a Rule

TO divide a plank equally, lay your rule diagonally across until the required number of divisions come to the two edges as shown in the illustration. The diagram



With the same ruler you may divide a board into any number of equal parts

shows how to divide a board into four and six equal parts.

If you are going to saw the plank at the marks, make the two outer edges slightly narrower by letting the rule overlap a shade, to allow for the waste in the saw cuts, otherwise the two outer pieces will be wider than the inside strips.

Two Small Envelopes Form One Large One

WHEN a long envelope is needed and only short envelopes are available, one of any desired length can be made by pasting together short envelopes, telescoping the ends after sitting them open. In this way the envelope can be made any length desired, and though it will not, perhaps, be as handsome as the regular article, it will be just as good for all ordinary purposes and can be made in odd sizes that cannot be purchased.—HOWARD GREENE.



One large envelope from two small ones



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Molding with Old Newspapers

By Harry B. Wilson

Winner of the Second Prize in the "New Uses for Old Things" Competition

NEWSPAPERS are fated to lose their dignity at an early age and herein I purpose to describe a means whereby they can be made of use.

I have molded many useful and ornamental forms by using macerated paper as a medium. Newspaper is easily decomposed by soaking in a tub of water. For the form described and illustrated, newspapers were soaked several days and were then well stirred and broken. A third of the pulp was put in a bucket and boiled from 5 to 10 minutes and to that 2/3 pt. of paperhanger's size was added. The water was then strained and pressed from the paper left in the tub and to this the sized pulp was added and mixed. In that state it was placed in the form or mold. The mixture contained

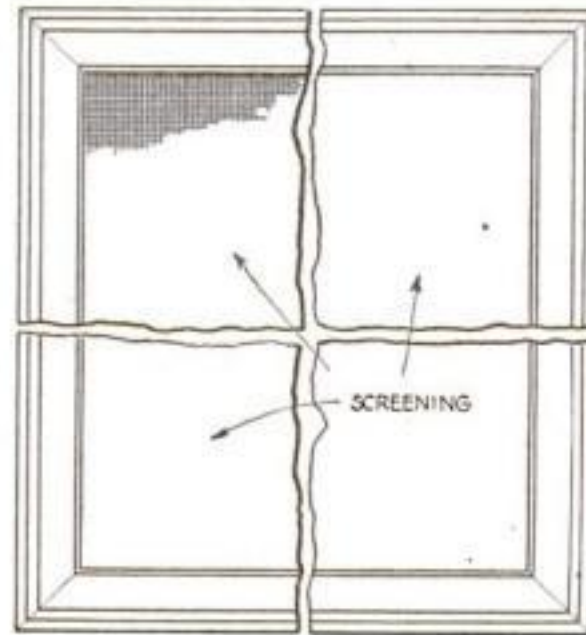


FIG. 1

Here the fireplace screen is shown forming the framework of the paper-pulp panel

was constructed by using an old picture-frame in combination with an old window-screen, the two conforming as shown in the picture with strips of lathing tacked around the top of the picture-frame to hold the composition to the proper thickness.

Before the prepared paper was placed in the mold, all rough places on the wood-work were waxed and then the entire inside of mold, including the wire screening, was brushed with a heavy oil.

Figure 2 shows the panel in detail; the back is formed by the use of cores as shown,

or roughly, with a trowel. After the composition has been arranged in the form, it is set out in the sun, where it may dry; most of the water will drip right through the screening and under the average conditions the panel may be removed in six hours.

When drying, the pulp shrinks, making it easy to remove when dry.

Hacksaw Handle from a Buckle-Rod

TAKE the buckle-rod of an old buck-saw and make a serviceable hack- or scroll-saw handle. Remove the loop ends of the buckle-rod and bend each rod at right angle at equal distances from center. The space between the bends should be equal to the length of a standard hacksaw blade. One of the two bent-up ends should then be bent back at a right angle to form the handle and the other end should be cut off to make it equal in length to the distance between the back of the frame and the handle-bend.

Harden the rod by hammering at the bend of the handle and at the other free end of the frame and drill holes for the

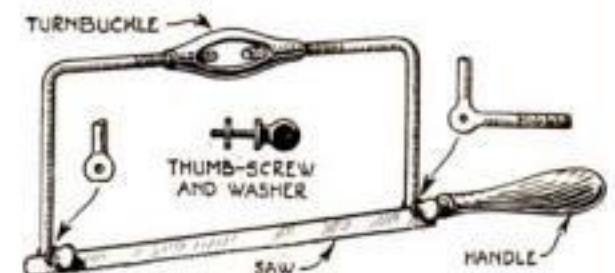


FIG. 2

Details of the construction of the mold and the making of the pulp covering of the screen are here shown

fragments of paper ranging from 1 in. in size to pulp.

During the summer the opening of the fireplace may be screened with a panel molded by using old paper as a material. Fireplaces are generally screened in some manner, as the black interiors detract from the neat appearance of the room.

The finished panel may be painted or calcimined whenever the walls of the room are done. Finished in that manner, it has the appearance of plaster or stucco; unfinished, the panel is a mist gray and by close observation fragments of print letters may be noted.

Figure 1 shows a plan of the mold in which the panel was formed. This mold

thumbscrews with square nuts, which serve to hold the hacksaw blade. The tension of the blade may be increased by turning the turnbuckle in the back of the frame. If the handle-rod is long enough it may be bent into a loop to form a handle. If it is too short for that, it may be driven into a wooden handle.—M. J. MUNSON.



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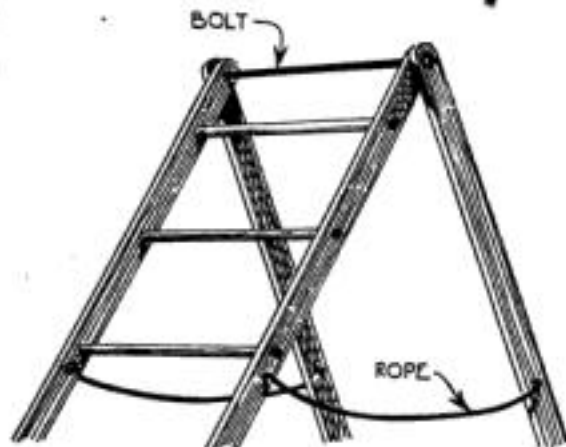
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(Please fill out all lines.)

Make a Step-Ladder from an Ordinary Ladder

IT is a simple matter to convert a short ladder into a step-ladder for use about the house. It is necessary only to drill two holes at the top of the ladder and attach two legs.

The legs should have enough strength to bear the weight of a person on the ladder.

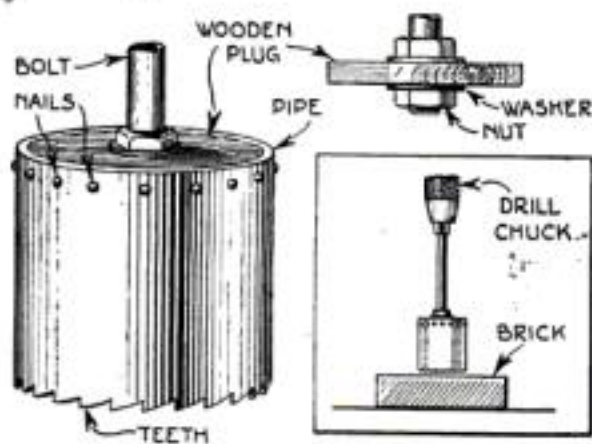


To make the bracing of the ladder more secure, the two props should be fastened together with cross-strips.

and it will be found that pieces about 1½ in. thick and 2 in. wide will be necessary. Holes are drilled in the ends of these also and they are held to the top of the ladder by small carriage-bolts. Two pieces of cord prevent the legs from slipping too far.

This Tool Will Drill Holes through Brick

FROM a short piece of an old iron pipe an efficient drill may be made that will cut through brick. The pipe is cut to the proper length and then put in the lathe and leveled at one end. If you have no lathe,



Bricks may easily be drilled with this homemade bit, which may be used in the chuck of any hand-brace.

you may file one end of the pipe to a slight bevel. Into this edge saw-teeth are filed. Near the opposite end holes are drilled and the pipe is case-hardened.

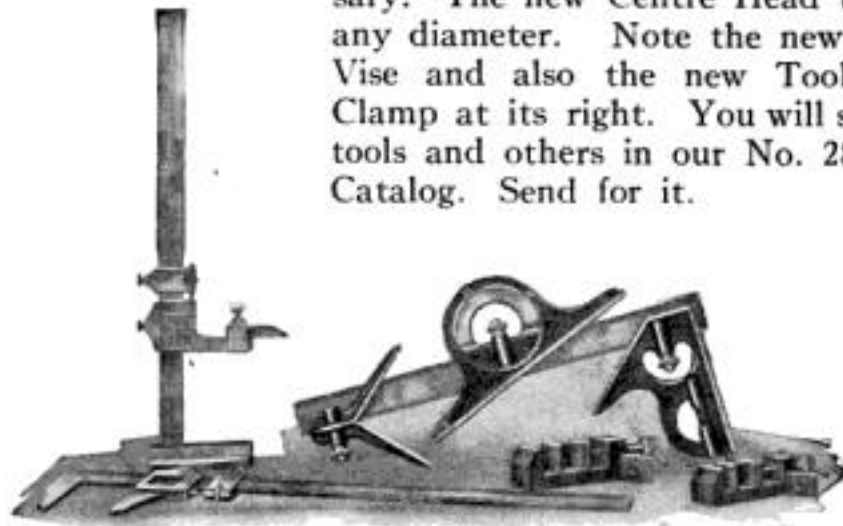
A circular wooden plug is next turned on the lathe to fit tightly into the pipe. In the center of this disk or plug a hole is drilled, large enough to accommodate a large screw-bolt. The bolt is fastened to the disk with two nuts and then the disk is fitted into the end of the pipe and held in place by nails driven into the wood through the holes drilled near the end of the pipe. The free end of the bolt should fit the shank of the drill-brace. When the drill is used, it should be rotated at 250 revolutions a minute and freely lubricated with water.

IMPROVEMENTS AND ADDITIONS

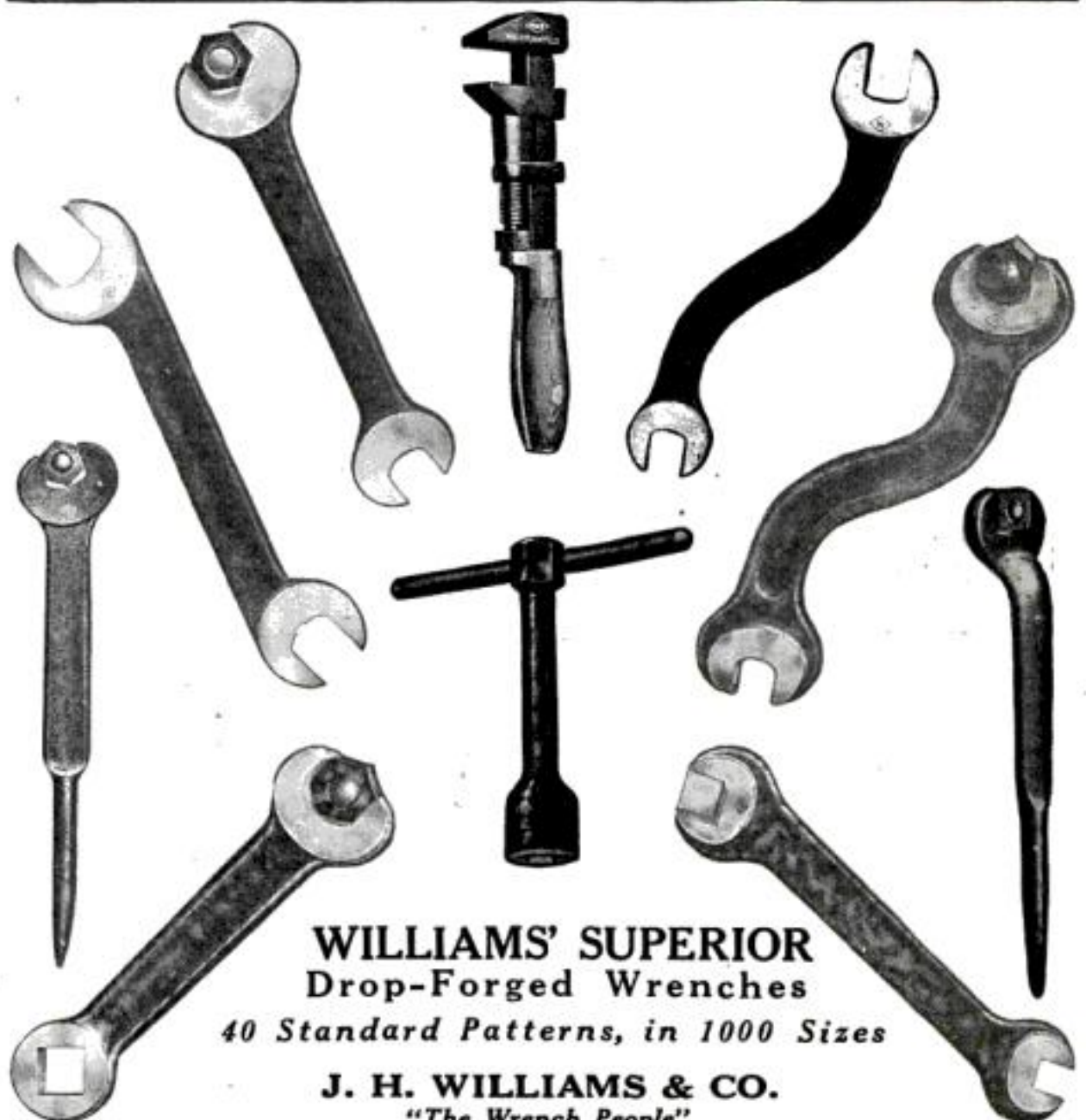
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The accuracy and fine workmanship in these tools will aid you in your work. The Vernier Height Gauge with new base, and also the Vernier Calipers, read inside and outside measurements in thousandths of an inch *DIRECT*—no calculations being necessary. The new Centre Head takes work of any diameter. Note the new Toolmakers' Vise and also the new Toolmakers' Vise Clamp at its right. You will see these new tools and others in our No. 28 Small Tool Catalog. Send for it.



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Why Babe Ruth is Greatest Home-Run Hitter

(Concluded from page 21)

him thrust the useful little curling-iron stylus in different-sized holes pierced through an electrified plate which registered contacts between the stylus and the side of the hole. These measured respectively sixteen, eleven, nine, eight, and seven sixty-fourths of an inch; small enough, but not too small for Babe, for he made a score for control that showed him better than 499 persons out of 500.

The tests that interested me most were those to determine how quickly Ruth's eye acts and how quickly its signals are flashed through the brain to the muscles. Showing an amazingly quick reaction time, they interpreted what happens on the ball-field when the stands rock under the cheering that greets another of Ruth's smashes to the fence, proved an eye so quick that it sees the ball make an erratic curve and guides the bat to follow.

The scientists discovered exactly how quickly Ruth's eye functions by placing him in a dark cabinet, setting into operation a series of rapidly flashing bulbs and listening to the tick of an electric key by which he acknowledged the flashes.

The average man responds to the stimulus of light in 180 one thousandths of a second. Babe Ruth needs only 160 one thousandths of a second. There is the same significance in the fact that Babe's response to the stimulus of sound comes in 140 one thousandths of a second as against the average man's 150 one thousandths.

Human beings differ very slightly in these sight and sound tests, or, rather the fractions are so small that they seem inexpressive; yet a difference of 20 or 10 one thousandths of a second indicates a superiority of the highest importance.

Translate the findings of the sight test into baseball if you want to see what they mean in Babe Ruth's case.

They mean that a pitcher must throw a ball 20 one thousandths of a second faster to "fool" Babe than to "fool" the average person.

If the results of these tests at Columbia are a revelation to us, who know Ruth as a fast thinking player, they must be infinitely more amazing to the person who only comes into contact with the big fellow off the diamond and finds him unresponsive and even slow when some non-professional topic is under discussion.

The scientific "ivory hunters" up at Columbia demonstrated that Babe Ruth would have been a "home-run king" in almost any line of activity he chose to follow; that his brain would have won equal success for him had he drilled it for as long a time in some line entirely foreign to the national game. They did it, just as they proved his speed and his steadiness—by simple laboratory tests.

For instance, they had an apparatus with a sort of a camera-shutter arrangement that opened, winked, and closed at any desired speed. Cards with letters of the alphabet on them were placed behind this shutter and exposed to view for one fifty-thousandth of a second. Ruth read them as they flashed into view, calling almost instantly the units of groups of three, four, five, and six letters. With eight shown, he got the first six, and was uncertain of the others. The average person can see four and one half letters on the same test.

When cards marked with black dots were used, Ruth was even faster. He called the number of dots on every card up to twelve without one mistake. The average person can see eight.

To test him for quickness of perception and understanding, he was given a card showing five different symbols—a star, a cross, and three other shapes—many times repeated, and was told to select a number—one, two, three, four, or five—for each symbol, then to mark the selected number under each one as rapidly as he could go over the card. He scored 103 hits on that test, which is the average of all who have tried it. But when given a card covered with printed matter and told to cross out all the a's, he made a score of sixty, which is one and a half times the average.

The secret of Babe Ruth's ability to hit is clearly revealed in these tests. His eye, his ear, his brain, his nerves all function more rapidly than do those of the average person. Further, the coordination between eye, ear, brain, and muscle is much nearer perfection than that of the normal healthy man.

The scientific "ivory hunters" dissecting the "home-run king" discovered brain instead of bone, and showed how little mere luck, or even mere hitting strength, has to do with Ruth's phenomenal record.

Emery-Wheel or Drill-Chuck for the Motorist

A POWER-DRIVEN emery-wheel or drill-chuck is a desirable tool for use in the garage, and the one shown in the illustration can be easily made and attached to the running-board of the car with a rear wheel jacked up to drive it.

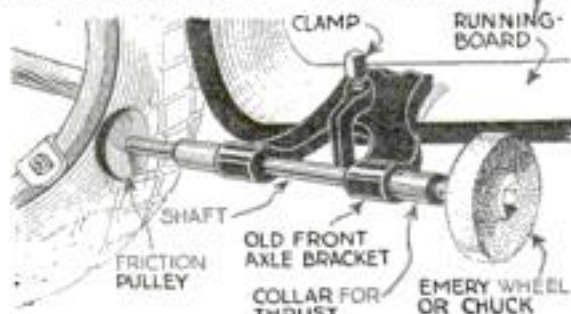
It consists of a yoke-shaped bracket that can be made from one end of a discarded front axle or other similar part, with a shaft and a pulley at one end of the shaft to drive from the tire of the rear wheel. The opposite end of the shaft is threaded.

By means of two nuts and washers a

small emery-wheel can be attached to the shaft. A small chuck threaded to fit the shaft can be secured in place of the emery-wheel. A clamp fastens the attachment to the running-board of the car.

This outfit, being detachable and light, can be carried in the tool compartment of the car at all times and is a desirable feature for the tourist.

The chuck used should have a jaw opening sufficient to take the stem of a valve, as truing valve faces is one of the details that the tool described can handle effectively.



This portable grinder is driven by friction against one of the rear wheels



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Slip-Joint Plier

for the
everyday repair job



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A plier designed to fit the hand and grip tight—tested to cut wire, nails, etc. Drop forged of tool steel of strength and dependability. Combines four practical tools in one—a wire cutter, burner grip, flat-nose plier and screw-driver. Beautifully nickel plated—7 inches long.

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"Red Devil" Glass Cutters—the glassiers' standard tools of the world. "It's all in the wheel." Made in 40 styles. No. 024 shown here, 20c.



This One



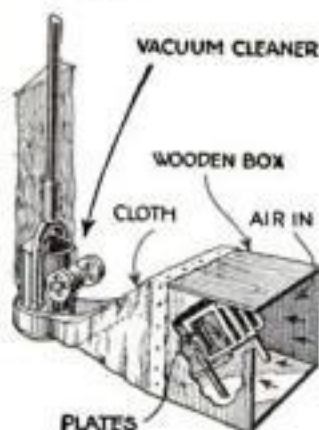
NJ08-DRF-FUEY





THE HOME WORKSHOP

Drying Photographic Plates with a Vacuum Cleaner



Another good use for the vacuum cleaner

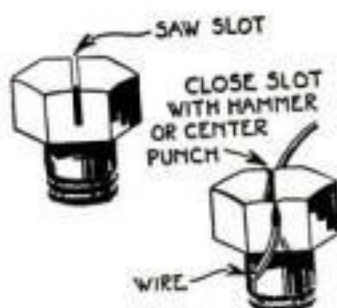
around the back and fastened tightly over the mouth of the vacuum cleaner. When the vacuum cleaner was set in operation, a rush of air passed through the box and in a few minutes the plates were dry.

Prevent Cap-Screws from Getting Loose

THERE are cap-screws with holes drilled through their heads for placing a wire to hold the screws from working loose on certain parts of the chassis. Sometimes, when repairing a car, a man loses or mislays these drilled-head cap-screws but has other bolts of the same size.

It is difficult to drill a small hole through the head of the cap-screw without breaking the drill. But there is a much easier way of attaining virtually the same result.

Use a hacksaw to make a cut across the head of the cap-screw. Then with a center punch, or the rounded end of a ball-pene hammer, strike the top of the slot, and so keep the wire from coming out.



Try this way of securing cap-screws

Pedal "Rubbers" May Be Made from Waste

BICYCLE or motorcycle owners will find leather more economical than rubber for covering the treadles.

The leather covers are built up of small disks, as shown. They may be punched out from any odd pieces of leather at hand, i. e., old boots and shoes, etc.

The cutting is done with a short length of 1-in. steel pipe, sharpened at the end. After the disks are punched, they are centered by a 1/4-in. steel tube, likewise sharpened at one end.

The leathers are threaded on spindles, with a washer at either end. They are as satisfactory as rubber, and last two or three times as long.—G. H. HOLDEN.



Leather treadles will outlast rubber ones

1/4 h.p. A.C. Motors as low as \$11.75

Here's your chance to buy one motor at a lower price than others charge for thousand-lots, or a hundred motors below the prices that washing machine manufacturers have been paying on contracts for five or ten thousand. Just compare these quotations with the advertised prices of other manufacturers in this or any other publication.

We offer, subject to prior sale, only 10,000 1/4 hp. motors at the following record-breaking bargain prices:

100 lots, each	-	-	-	\$11.75
25 " "	-	-	-	12.00
12 " "	-	-	-	12.25
6 " "	-	-	-	12.50
3 " "	-	-	-	13.00
Single Motors	-	-	-	13.50

F. O. B. Chicago

This offer will turn the motor business upside-down and put an end to fancy prices. Motors are latest type, fan-cooled, 110 volts, 1740 rpm, 60 cycle, single-phase, alternating current, with either binding post or cord and plug terminal. Rating 1/4 hp; but every motor before leaving factory is tested for 50% overload. They can be attached to any light or power circuit.

Just the thing for operating washing and ironing machines in the home; small lathes, grinders, drill and similar tools in the shop; churns, cream separators, feed mills, etc., on the farm.

Every Motor Bears a Guarantee Service Tag. This guarantee provides free consulting service for a year and, if anything should go wrong with the motor within 12 months—you ship it back express charges collect and get a BRAND NEW MOTOR express prepaid. No other motor maker ever had the nerve to make such an offer. Hundreds of thousands of these motors are in use all over the world and every buyer is a booster.

The low price is made possible by the remarkable simplicity of the motor. It has only half as many parts as most other motors of the same rating. This simplicity also means economy of electricity and absence of repair expense.

At these extremely low prices CASH MUST ACCOMPANY ORDER

You run no risk as all our motors are sold on the money-back basis if you are not fully satisfied.

We cannot agree to repeat the prices quoted. Better act promptly, as this one ad may sell the entire lot—possibly to one washing machine manufacturer.

NORTHWESTERN ELECTRIC COMPANY

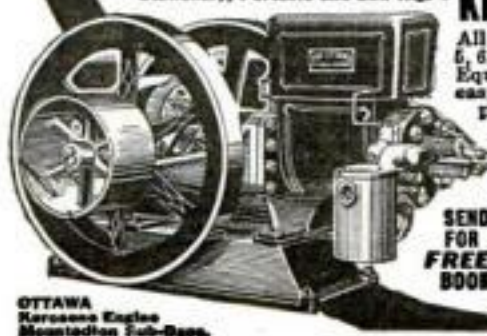
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\$38.50 FOR 2-H. P.
—All Other Sizes at Proportionally LOW PRICES.

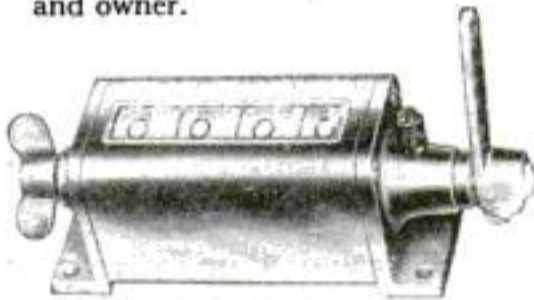
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You have too much money invested in your machine—pay too much for its operation—to leave off this final equipment that gets the production. . . A

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brings out all there is in a machine, all there is in the operator, all there is in it for inventor and owner.



The above Revolution Set-Back Counter records the output of any machine where a shaft-revolution indicates an operation. Sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figure-wheels, as illustrated, \$10.00—subject to discount. Cut less than one-half size. Set-Back Rotary Ratchet Counter, to record reciprocating movements as on punch presses, \$11.50 (list).

The Hand Tally illustrated below is used for counting anything from number of people attending a ball game, to number of packages in an inventory. In the public place it counts persons; in the factory or store it counts stock; in the "open" it may count anything from cattle on a ranch, to poles on a telephone line! Registers one for each pressure of the thumb lever; counts up to 10,000, then repeats. Can be set back to zero from any figure by turning knob once round. Size, exclusive of finger ring, 2 inches greatest diameter. Price, \$5.00.



The Veeder booklet shows counters for every purpose where an accurate count is of value. Write if you haven't a copy—for it's free.

The Veeder Mfg. Co.,
44 Sargeant St., Hartford, Conn.

How I Made a Washing-Machine at Home

By William E. Beazley

Winner of the Third Prize in the "New Uses for Old Things" Competition

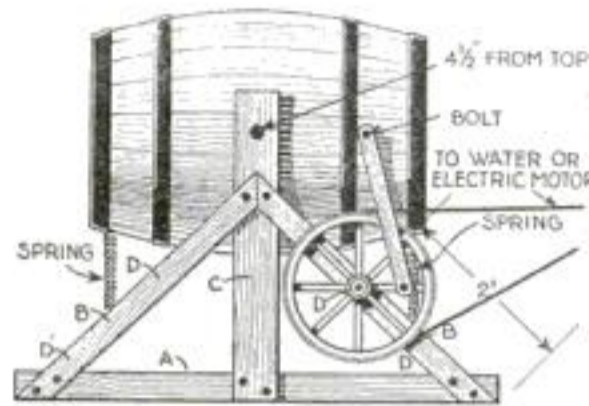
FOR building this washing-machine the following material is required: a barrel, some hard-wood bed-slats, a piece of pipe, 4 elbows, three 3-inch nipples, four 2-inch nipples, 2 floor-flanges, fittings for the pipe $\frac{1}{2}$ in. in diameter, and a grooved wheel 14 in. in diameter.

The bed-slats, or some hard-wood strips about 3 in. wide and $\frac{3}{8}$ in. thick, should be cut as follows:

2 pieces	3 feet 9 inches (A)
4 pieces	2 feet 8 inches (B)
2 pieces	2 feet 10 inches (C)
4 pieces	1 foot 11 inches (D)

Two frames should be made exactly alike. The frames are connected by 4 slats 1 ft. 11 in. long, joined at DDDD. With 2-in. screws and a straight drive the frame will be quite rigid. The barrel is 24 in. long and its diameter is 14 in.

With a crosscut saw cut a section between the iron hoops about 8 in. wide; the



Making a washing-machine like this means a saving of time, money, and energy

length will depend on the distance between the hoops, but it should be as long as possible. This cut-out section should be made into one solid piece by two straps of iron screwed on. The straps should overhang 1 in. on either side to keep it in position.

A 3-in. bolt is put into the barrel on the center line 8 in. from the center. The

grooved wheel is fastened with a set-screw on the outside of the frame on the 8-in. pipe. A piece of hard wood is connected with the driving-wheel and the bolt on the barrel.

The machine is driven by a $\frac{1}{4}$ -hp. motor geared down to give 60 revolutions a minute. Fifteen minutes' operation will thoroughly wash a large batch of clothes, using plenty of soap.

There is nothing about this machine that any boy cannot do and the saving of labor for the hard-worked mother will be ample compensation for the little work required.

Secret Doorknob Assures Office Privacy

INTRUSIONS by inopportune visitors who boldly enter your private office unasked while you are engaged in an important conference may be prevented in a large measure by the use of modified doorknobs such as described and illustrated here. These knobs do not differ in outward appearance from other doorknobs, but they can be opened only by those who know the secret.

The method of changing an ordinary doorknob to one that is intrusion-proof is described below.

First, the square shaft which passes through the door and to which the knobs are fastened should be removed and turned down on one end for a distance equal to the depth of the socket in the knob. Then the socket of the knob is bored out round. Two bushings are then made to fit loosely over the rounded shaft and into the knob socket. These bushings should be filed on one end to form teeth, as shown in the sketch. (Four teeth will be sufficient.) These teeth should point the same way on bushings so that when one bushing is reversed, the teeth will interlock.

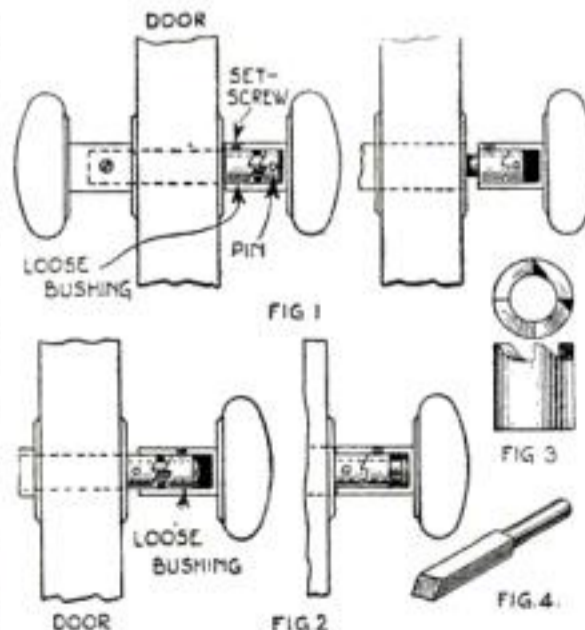
The knob is now ready to be assembled. The bushings are slipped over the rounded end of the shaft, with their teeth together.

The bushing on the outer end is then pinned to the shaft. The socket of the knob is slipped over the bushings and tightened on the inner bushing by a set-screw. The inner bushing should be indented to take the set-screw. The knob is now ready for use.

In Fig. 1 is shown the arrangement of the parts for a door that swings inward. When opening such a door, the natural tendency is to push on the knob before turning. With the arrangement shown, the knob must first be pulled out and then turned to open the door. This causes the teeth of the bushing to interlock and when the knob is turned, the latch is drawn.

On a door that opens outward, the tendency is to pull before turning; consequently, the knob should be so arranged that it must be pushed before turning. The arrangement shown in Fig. 2 is practically the same as that in Fig. 1, with the following exception: the inner bushing is pinned while the outer is held by a set-screw, simply the reverse of Fig. 1.

It will be noticed in Fig. 2 that the end of the shaft is slightly riveted. This prevents the knob from slipping off should any one pull on it. All movable parts of the doorknob mechanism should be well oiled from time to time.—R. H. KASPER.



Only those who know the secret will be able to use this doorknob



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Victor Talking Machine Co., Camden, N. J.



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